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Report of the Work of The Rubber Research Board in 1940.

(*Established under the Rubber Research Ordinance Chapter* 302).

March, 1941.

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The present report is the Tenth Annual Report of the Rubber Research Scheme (Ceylon) as constituted under the Rubber Research Ordinance (Chapter 302).

CHAIRMAN'S REPORT

Board Membership.—The three-year period of the following nominated members of the Board terminated during the year and appiontments to fill the vacancies were made as indicated below :—

Mr. I. L. Cameron, April 15th. Renominated for a further period of three years.

Mr. L. B. de Mel, J.P., U.P.M., April 12th. Mr. L. M. M. Dias appointed.

Mr. G. E. de Silva, M.S.C., July 13th. Renominated for a further period of three years.

Mr. B. M. Selwyn. June 25th. Mr. J. D. Farquharson appointed.

The following additional changes in the membership of the Board occurred during the year :—

Mr. I. L. Cameron was on leave from February 7th., and Mr. R. J. Hartley was nominated to act for him.

Mr. E. Rodrigo was on leave from October 14th. Mr. M. Park acted for him until November 10th and Mr. M. Crawford from November 11th.

Mr. S. Phillipson, C.C.S., Deputy Financial Secretary, was deputed to represent the Financial Secretary from December 7th in place of Mr. C. H. Collins, C.C.S.

Mr. B. M. Selwyn, who resigned on his retirement from Ceylon, had served on the Board since 1932, and was Chairman of the Experimental Committee from May, 1939. The Board paid a tribute to his work at a meeting held on June 10th, 1940.

Mr. C. H. Collins, Deputy Financial Secretary, had represented the Financial Secretary on the Board since 1934. A vote of appreciation of his services was recorded at a Board Meeting held on January 20th, 1941.

The personnel of the Board at the end of 1940 was as follows :—

Ex-Officio Members.

The Acting Director of Agriculture, Mr. M. Crawford (Chairman).
Representing the Financial Secretary — The Deputy Financial Secretary (Mr. S. Phillipson, C.C.S.)

Unofficial Members of the State Council nominated by the Governor.

Mr. G. E. de Silva, M.S.C.
Mr. R. C. Kannangara, M.S.C.
Mr. E. C. Villiers, M.S.C.

Members nominated by the Ceylon Estates Proprietary Association.

Mr. L. P. Gapp.
Mr. J. C. Kelly.

Members nominated by the Planters' Association of Ceylon.

Mr. J. D. Farquharson.
Mr. F. H. Griffith, M.S.C.

Members nominated by the Rubber Growers' Association.

Mr. R. J. Hartley (Acting).
Mr. E. W. Whitelaw.

Members nominated by the Low-Country Products Association.

Mr. T. Amarasuriya.
Mr. L. M. M. Dias.
Mr. T. C. A. de Soysa.
Mr. N. D. S. Silva.

Members nominated by the Governor to represent Smallholders.

Mr. W. P. H. Dias, J.P.
Mr. F. A. Obeyesekere.

Meetings.—Meetings of the Board were held at Dartonfield on January 18th and in Colombo on March 20th, June 10th, September 2nd, and October 28th. The Board is again indebted to the Ceylon Chamber of Commerce for the use of its Committee Room for meetings held in Colombo.

Committees.—

Experimental Committee.—Mr. F. H. Griffith resumed the Chairmanship of the Committee on the retirement of Mr. B. M. Selwyn. Mr. R. C. Kannangara succeeded Mr. Selwyn as a member of the Committee. The personnel of the Committee at the end of the year was as follows :—

Mr. F. H. Griffith, M.S.C.
Mr. W. P. H. Dias, J.P.
Mr. R. C. Kannangara, M.S.C.
Mr. F. A. Obeyesekere.
The Director (Convener).

Meetings of the Committee were held on February 28th, April 27th, July 17th, August 28th, August 30th, October 8th, and December 17th.

Smallholdings Committee.—There were no changes in membership. The personnel of the Committee at the end of the year was as follows :—

Mr. W. P. H. Dias, J.P.
Mr. F. A. Obeyesekere.
The Smallholdings Propaganda Officer.
The Director (Chairman and Convener).

Meetings of the Committee were held at Galle on May 3rd and at Ruanwella on August 9th, in conjunction with inspection of the work of the department in the respective ranges.

"Ad hoc" Committees.—A Committee consisting of Messrs. C. H. Collins, B. M. Selwyn and F. A. Obeyesekere made recommendations to the Board on the rate of contribution to the Employees' Provident Fund.

London Advisory Committee for Rubber Research (Ceylon and Malaya).—The Board contributed jointly with the Rubber Research Institute of Malaya to the cost of research on the quality and utilisation of raw rubber carried out at the Imperial Institute, London, under the control of the London Advisory Committee for Rubber Research (Ceylon and Malaya). The Board's contribution during the year amounted to £875 which represents 25 per cent of the total cost of the work.

Meetings of the Advisory Committee and Technical Sub-Committee were held on January 26th and May 24th. Meetings of the Standardisation Sub-Committee were held on January 10th and August 23rd.

The death of Sir Herbert Wright, who had served on the London Advisory Committee for many years and was a pioneer of the Ceylon rubber industry, is recorded with regret. Sir Frank Stockdale resigned from the Committee on receiving an appointment abroad and was replaced by Dr. H. A. Tempany, C.B.E., his successor as Agricultural Adviser to the Secretary of State for the Colonies.

Employees' Provident Fund.—It was decided to increase the rate of contribution and the Board's bonus from 5% to 7½% of the employees' salaries, and to hand the Fund over to Trustees for administration. The Chairman, the representative of the Financial Secretary, the Director, and Mr. R. J. Hartley were appointed as Trustees of the Fund. Revised rules of the Fund were under consideration at the end of the year.

FINANCE.

Income.—The Board's main income was derived from the cess of ½ cent per pound levied on exports of rubber under Section 6 (1) (a) of the Rubber Research Ordinance. Income from this source was again in excess of the estimate owing to the increase in the permissible exportable amount under the Rubber Regulation Ordinance in the latter part of the year. Monthly cess collections were as follows :—

January	... ...	Rs. 22,023
February	... ...	„ 23,595
March	... ...	„ 14,794
April	... ...	„ 13,059
May	... ...	„ 18,627
June	... ...	„ 16,683
July	... ...	„ 19,363
August	... ...	„ 24,643
September	... ...	„ 25,563
October	... ...	„ 24,522
November	... ...	„ 17,438
December	... ...	„ 25,740
		Rs. 246,050

The proposals for stabilising the Board's income, which were referred to in the report for 1939, were criticised by one of the Associations to which they were submitted for comments. It was decided (early in 1941) that no further action should be taken in the matter.

A profit of Rs. 26,556 was derived from the normal working of Dartonfield Estate and Rs. 10,866 from Nivitigalakele.

Expenditure.—Current expenditure amounted to Rs. 201,904, leaving a surplus for the year of Rs. 92,553.

Capital expenditure amounting to Rs. 11,261 was mainly incurred in respect of agricultural development at Dartonfield (Rs. 1,510) and Nivitigalakele (Rs. 4,823), and of laboratory equipment (Rs. 1,739).

Accounts.—The accounts of the Scheme have been audited by the Auditor-General and his report, together with a balance sheet and statement of income and expenditure, are attached.

TECHNICAL REPORTS.

The reports of the Director, Chemist, Botanist and Mycologist, Soil Chemist, Smallholdings Propaganda Officer and Estate Superintendent are also attached. The report of the London Advisory Committee for Rubber Research (Ceylon and Malaya) will be submitted when available.*

(Sgd.) E. RODRIGO,
Chairman of the Board,
Rubber Research Scheme (Ceylon).

10th March, 1941.

* To be issued as a supplementary publication.

DIRECTOR'S REPORT FOR 1940.

The work of the Rubber Research Scheme has not, up to the present, been seriously disorganised by the War. The absence of three members of the scientific staff for short periods of service with the Ceylon Defence Force, at intervals during the year, has not been without effect on the Scheme's activities, but it has been found possible to avoid interference with the main investigations which are in progress. As stated in last year's report it is the policy of the Research Board to proceed with a normal programme of research as far as possible.

A summary of the year's activities is given below and more detailed accounts of the work are available in the departmental reports which are attached.

STAFF.

Director.—Mr. T. E. H. O'Brien was absent on an official visit to Malaya, Sumatra and Java from February 9th to March 23rd, and on leave from March 30th to December 4th. During these periods Mr. R. K. S. Murray acted as Director. The Director's service agreement was renewed for a period of 3 years and 8 months from December 19th, 1940.

Chemical Department.—Mr. M. W. Philpott, Chemist, was on duty during the year, subject to short absences on military service.

Botanical Department.—Mr. R. K. S. Murray, Botanist and Mycologist, was in charge of the department in addition to his duties as Acting Director.

Dr. C. E. Ford, Geneticist, was on duty during the year, subject to absences on military service which included one period of 6 weeks.

Mr. C. A. de Silva, Assistant Botanist, was on duty during the year.

Soils Department.—Dr. L. A. Whelan, Soil Chemist, was on duty during the year, subject to short absences on military service.

Smallholdings Department.—Mr. W. I. Pieris, Smallholdings Propaganda Officer was in charge of the department during the year.

Estate and Experiment Station.—Mr. D. L. Nicol, Estate Superintendent, resigned his post with effect from 31st August, 1940. Mr. G. P. N. de Silva succeeded him and assumed duties on 18th September, 1940. Mr. C. A. de Silva acted as Estate Superintendent in the interim period.

Release for War Service.—The Board decided that any officer, except the Director or officer officiating as such, may be released for war service on terms which are very generous to the employee, and which provide

for completion of the period of engagement after demobilisation. One officer was accepted for service but the appointment was subsequently cancelled on official representations that his technical services were likely to be required in Ceylon.

BUILDINGS.

No construction was undertaken during the year.

CHEMICAL DEPARTMENT.

Latex.—In previous annual reports reference has been made to the growing importance of latex as an industrial raw material, and to the efforts made by the Research Scheme to interest Ceylon producers in the market for this product. During the current year a considerably increased demand for latex (38-40% and 58-60%) developed in India. Small shipments were made regularly from Dartonfield but requirements were far in excess of the amount which could be supplied. A letter explaining the position was sent to local Producers' Associations and resulted in a few enquiries, but the general response was disappointing. It will be unfortunate if Ceylon misses this opportunity of gaining experience of the latex trade, which can be expected to show considerable expansion after the war.

In anticipation of difficulties in importing supplies of the usual creaming agents attention was given to the possibility of using local materials. Grades of Indian gum tragacanth were tested and found to be very variable in their creaming properties. Tamarind seed gum, the use of which has already been studied by the Rubber Research Institute of Malaya, gave promising results and its properties were examined in some detail. The main difficulty in using this material is to separate the gum from the insoluble husk. Some progress was made in developing a suitable method of preparation.

Trials were undertaken to test a statement that the creaming capacity of latex is improved if ammoniation is delayed as long as possible. An increase of 1½—2% in the D.R.C. of the cream was obtained by this means, but there was no increase when the creaming was carried out in the presence of 0.3% of soap. It seemed probable, therefore, that the change which occurs in ammoniated latex during the first few hours after collection is equivalent to the addition of a small proportion of soap.

Variability of Raw Rubber.—Considerable attention was given to work on the variability of raw rubber.

All local estates over 1,000 acres in extent were invited to provide samples of their normal produce for examination, and supply particulars of methods of preparation. Samples were obtained from 72 estates, representing about 1/5 of the Island's production. It is of interest to find that the majority of the larger estates prepare crepe as opposed to

smoked sheet. Vulcanisation tests were made on the samples using the standard accelerator and rubber-sulphur mixings, and the results examined to establish the average properties and range of variation. The values for smoked sheet corresponded almost exactly with the results of a similar survey undertaken in Malaya.

Monthly tests on the rubber from Dartonfield were continued during the year. The rubber is exceptionally slow curing compared with the local average established from the estate survey. Crepe remained substantially uniform in properties during the year whereas smoked sheet showed a slight but well defined variation when tested in the accelerator mixing, but not in the rubber-sulphur mixing. This rather unexpected result is further discussed in the Chemist's report.

Tests on samples prepared immediately after the annual resting period confirmed last year's observation that the vulcanising properties are not abnormal during this period. Monthly tests on samples from the experimental tapping plots showed variations in the uniformity of the rubber under various tapping systems but further data are required before the figures can usefully be discussed. Periodical tests were continued on rubber from monoclonal blocks at Nivitigalakele and an estate.

A preliminary study was made of the effect on the properties of the rubber of various modifications in factory procedure. A factorial design of experiment was adopted in which several variations in procedure are compared in all their combinations. Two experiments of this type, carried out at Dartonfield, gave interesting results and it is hoped to extend the trials to other estates during 1941.

Sheet rubber rolled at Dartonfield was distributed to 12 estate smokehouses of various types. Vulcanisation tests on the rubber revealed a considerable range of modulus values, suggesting that variation in smoking conditions may be a major factor in the total variability of estate sheets.

Purified Rubber.—Tests carried out in London on a small consignment of partially purified rubber, which had been prepared by the coagulation of twice creamed latex, confirmed that the rubber had a moderately low water absorptive capacity, that it aged fairly satisfactorily and cured slowly. A few trials were made to study the possibility of preparing an improved form of purified rubber by centrifuging fresh latex. The interest of this line of work is based on the observation that rubber prepared from such latex retains its natural resistance to ageing whereas rubber derived from alkaline latex usually has inferior ageing properties.

Rubber Coagulants.—The total imports of acetic and formic acid into Ceylon during 1940 were well in excess of current needs, and it is estimated that stocks at the end of the year amounted to more than 6 months' requirements.

In the early months the shortage of normal coagulants, arising from dislocation of supplies at the beginning of the war, was felt by all classes of producer and, as discussed more fully in the report of the Smallholdings Department, small producers continued to feel the effects of the shortage throughout the year. Considerable time was given to the examination of alternative coagulants, including many proprietary products which were developed by enterprising traders. A report on the subject, published in the Quarterly Circular, showed that most of the proprietary substitutes contained sulphuric acid and were offered at prices out of all proportion to their commercial value.

Opinions were obtained from the managers of fifteen estates who had tried the "re-use of serum" method of reducing acid consumption. The general experience was that the saving in acid was negligible in comparison with the loss due to the production of off-grade rubber. It is concluded that this method can only be recommended as an exceptional measure, under Ceylon conditions.

Advice was given to the Department of Industries on the local production of acetic acid from coconut shells, and samples from the Department's experimental plant were tested from time to time.

The Preparation of Clean Rubber.—The factory procedure recommended by the Research Scheme for the preparation of clean rubber was adopted by a number of additional estates during the year. The main feature in this procedure is the provision of settling tanks in which the diluted latex is allowed to stand before being run off into separate coagulating tanks. A series of tests showed that day-to-day variation in the viscosity of 20% latex is negligible; this observation is of interest because it indicates that the efficiency of settling is not likely to vary from day to day. It was calculated on theoretical grounds that the period of settling recommended by the Research Scheme should lead to the removal of sand particles with a diameter larger than 1/400 inch.

Packing Rubber.—Arising from a request from the Colonial Office that Rubber producers should discontinue the use of plywood chests for packing rubber, enquiries were made from local shippers regarding the methods of packing in use. It was found that the greater part of Ceylon's rubber is already exported in sized hessian (or gunny) covered bales. An appreciable amount of smoked sheet is packed in "bare-back" bales.

A short article on the subject was published in the Quarterly Circular.

BOTANICAL AND MYCOLOGICAL DEPARTMENT.

Oidium Leaf Disease.—The incidence of Oidium was exceptionally light in most districts except at the highest elevations. This was attributed to the hot, dry weather and absence of low minimum temperatures in the early months of the year, which were inimical to the activities of the fungus but favourable to rapid maturation of the young leaf.

Weather conditions were ideal for sulphur dusting operations, the success of which may be regarded as having contributed materially to the excellent foliage obtained on mid-country estates. In the main low-country districts the foliage was also better than has been seen for a number of years.

Experimental work was confined to the search for trees resistant to infection. Trees which had been marked on two estates as possibly resistant in 1939 were inspected, but the foliage appeared to be no less susceptible than that of other trees in 1940. Reports from other estate superintendents were equally disappointing.

Arrangements were made to lease 25 acres of land planted with Rubber on Kepitigalla Estate, Matale, for the purpose of establishing a "museum" collection of clones, which will be utilised to study relative susceptibility to Oidium. Efforts to lease a suitable block of land for the purpose from Government proved unsuccessful.

Root Diseases.—Root diseases continue to give trouble in replanted clearings but the actual loss of plants seldom greatly exceeds 1% of the total stand. There is also evidence that the incidence of disease shows a marked decrease in the third or fouth year after planting, provided the correct treatment is undertaken as each fresh centre of infection is discovered. Periodical root inspection has been carried out on some estates but in an experimental comparison there has, so far, been no evidence that the treatment has paid for itself by reducing the number of later losses.

Diseases of Budgrafts.—Cases of a diseased condition just above the union of young budded plants have been observed in replanted areas at Dartonfield and on estates. In an advanced stage the bark is dead for a distance of 2 or 3 inches above the union and the foliage becomes unhealthy owing to the "ringing" effect. A few cases were examined at an earlier stage and in every case the damage was found to have started on the underhung portion of the scion just opposite the snag. It is thought possible that the trouble had originated owing to unduly moist conditions round the plants, which were provided with protecting baskets, although the symptoms were usually first observed during the dry weather.

Numerous specimens were received of budgrafts which had suffered from sun-scorch of the union during the hot dry weather in the early part of the year. A description of the disease was published by the Research Scheme as far back as 1933, and advice has consistently been given that the unhealed unions should be shaded during dry weather. There were a few instances of sun-scorch of the green stem of young budgrafts.

Dieback of Pueraria.—Reference was made in the last report to an investigation of cases of dieback of Pueraria in areas where the cover had been established for some years. Information received from Superintendents whose estates were visited in connection with the investigation indicate that the present position is substantially as follows :—

(1) Once a cover has deteriorated badly it does not, in general, show any recovery even after the application of phosphatic manures.

(2) Attempts to re-establish Pueraria have been unsuccessful, but other covers, mainly *Desmodium ovalifolium*, are coming away well.

(3) In general, areas of healthy cover which have been manured with general mixtures during the past 9 months have not shown any deterioration.

Pests of Cover Plants.—A severe attack of a boring caterpillar, *Indarbela quadrinotata*, on Albizzias was reported from one estate. The borers had also gained entrance to a number of 3-year-old budgrafts, but were apparently only able to do so where an unprotected wood surface was exposed. There was no indication of the Rubber trees having suffered as a result of the attack, and plugging the holes with a plastic compound appeared to kill the insects enclosed in the galleries.

Planting Material.—An experiment was carried out to determine the effect of immersing the taproot of budded stumps in a solution of Hortomone A before transplanting, and a comparison was also made between cutting the lateral roots at 3, 6 and 12 inches from the taproot. Root inspection of sample stumps showed that the Hortomone treatment had stimulated root growth. There was, however, no evidence that the stimulus to rooting had improved the growth of budshoots. The conclusion was reached that, under average local conditions, there is litte advantage to be gained by the use of Hortomone A.

Nursery plants established in families from the illegitimate seed of a number of clones, were used for observations on the root system height and girth of stem, and yield on pricking with the "Testatex" knife. A summary of the data is given in the Botanist's report. Growth was comparatively uniform in spite of substantial variations in the weight of roots. The best reaction to pricking was given by plants whose parents are known to give valuable seedling progeny *viz.* Tj. 1, AV. 163, and BR. 2.

Tapping was started in March in the experiment which is being undertaken at Mukalana Estate to obtain data on the effect of the yield of the stock on that of the scion. The trees which were budded at a height of 3 feet, are being tapped on the 2S/2, d/4, 100% system, one cut being above and one below the union.

A new clone trial area of 10 acres was planted with budded stumps at Nivitigalakele. Thirty six clones are included, being mostly the newer clones developed in Malaya and the N.E.I. Test plots of the most promising Ceylon clones have been established on estates in the Kalutara, Ratnapura, and Matale districts to study their reactions to different environmental conditions.

Test-tapping of Ceylon clones was continued at Nivitigalakele, Wagolla, and on various estates co-operating with the Scheme. Two clones, Millakande 3/2 and Wagga 6278, are now recommended (with reservations) for commercial use on a large scale. Hillcroft 28 is recommended for planting on a relatively small scale. Records of the test-tapping and commercial tapping of imported clones have also been received from estates. Most of the records are satisfactory when the previous history of the areas in question is taken into account.

A publication describing and illustrating the vegetative characteristics of six of the most promising local clones was prepared by the Geneticist and was with the printers at the end of the year.

Breeding Investigations.—Nearly 6,000 artificial pollinations were made during the 1940 flowering season, using five local and two imported clones as parents. The results were very disappointing for various reasons; two clones again failed as seed parents, one clone was pollen sterile or nearly sterile, and one tree which was carrying a good crop of seeds was blown down. Approximately 300 plants were established as a result of the work.

Arrangements have been made for six seed gardens to be established on estates in 1941 with the clones used in the artificial pollination programmes.

As an outcome of the Director's visit to Malaya, Java and Sumatra a recommendation was made to the Board that the scope of the Scheme's breeding and selection work should be considerably enlarged. The recommendation was accepted in principle and, after consideration of more detailed proposals, an application was made to Government early in 1941, for the lease of approximately 1 square mile of land for future experimental planting.

Tapping.—The tapping experiment in mature seedling Rubber on Dartonfield completed its third year in February, 1940. The results for the three years were published in the Quarterly Circular, and are summarised in the Botanist's report. An interesting feature of the results is that the yield on the 2S/2, d/3, 133% ("double three") system has shown no indication of falling off and the dry rubber content of the latex remains at a satisfactory level. The adoption of this system has been suggested as a temporary expedient on estates which anticipate difficulty in harvesting their standard assessment in 1941, owing to areas having been replanted.

Drastic tapping was undertaken during 1940 in an area of about 3½ acres on Dartonfield which is to be replanted in 1941. Tapping was on the 2S 2, d 2, 200% system from March until November, when an extra cut was opened on each side of the tree. Yield for the year was 860 lbs. per acre, which probably represents an increase of about 60%.

Four tapping experiments in budded areas on estates were continued and the results are discussed in the Botanist's report. With clone Tj. 1 tapping of 67% intensity led to a reduction in yield of 15%—20% whereas with clones AV. 49 and BD. 5 the reduction was approximately equal to the theoretical figure of 33%. There was a relative increase in the yield on the 2S/2, d/4 and S/1, d/4 systems, compared with the previous year's figures.

Two small experiments were started at Nivitigalakele utilising available trees of clones MK. 3/2 and HC. 28 in single tree plots, for a comparison of 3 tapping systems in one case and 2 in the other. The yield on the S/3, d/2, 67% system was slightly more than 75% of that on the S 2, d/2, 100% system.

Natural Covers.—Observations were continued in the mature area at Dartonfield which is being utilised for studying the so called forestry method of cultivation. There is now a useful mixed cover over the greater part of the area. Yield figures which are reviewed in the Botanist's report indicate that the improved type of vegetation which has gradually been established may now be exercising a directly beneficial effect.

Replanting Experiments at Dartonfield:—

Area No. 1. (1934).—The experiment to compare (1) methods of disposal of the old timber (2) species of ground cover crops (3) methods of controlling the ground cover, was terminated on the completion of 6 years' growth, and the trees will be utilised for a tapping experiment in 1941. The results and conclusions were summarised in the Quarterly Circular. Up to the third year the more vigorous covers, Pueraria and Centrosema, appeared to exercise a greater retarding effect on growth than the lighter covers, Calopogonium and Vigna, but, thereafter the opposite tendency was noticed. The timber treatments were inconclusive but it may be noted that none of the outbreaks of root disease occurred in plots from which the larger lateral roots were removed.

Area No. 3 (1936).—This area provides comparisons of three methods of opening the land, three methods of planting, and the effects of manuring with organic and inorganic mixtures. Differences in growth under the three methods of opening are not significant on the basis of the 1940 measurements, but the plants in the pitted drain plots are still somewhat smaller than those in the contour trench and contour platform

plots. The stumped buddings retain their advantage over the budded stumps and both are significantly larger than the plants budded in the field. The fertiliser comparison is discussed in the Soil Chemist's report.

Bark Renewal.—An experiment was started at Dartonfield to determine whether periodical applications of certain vegetable oils have a beneficial effect on bark renewal. After 6 months no effect was evident but the trial is being continued.

SOILS DEPARTMENT.

Close co-operation was maintained during the year between the Soils and Botanical Departments, and the Assistant Botanist continued to supervise field manurial trials laid down at Dartonfield and Nivitigalakele before the Soils Department was formed.

Manuring.—Recommendations for routine manuring have been influenced by supply difficulties arising from the war. Sulphate of ammonia was not available for general Rubber manuring and the choice of artificial nitrogenous fertilisers rested between calcium cyanamide and nitrate of soda. The former has usually been recommended, mainly owing to the lower cost per unit of nitrogen. In using nitrate of soda it has been suggested that the dose should be divided and applied at different times in order to minimise the risk of loss by leaching.

Shortage of supplies of muriate of potash led to an arrangement whereby the quantity included in manure mixtures for mature Rubber was reduced to half the quantity normally applied or to 20 lbs. per acre, whichever is the greater. On the advice of the Research Scheme supplies for use in young Rubber areas were not restricted. Superphosphate was not available but there was no shortage of rock phosphate and bonemeal. A short note on the war-time fertiliser position was published in the Quaterly Circular.

The fertilizer trial in mature Rubber at Dartonfield has now completed the fifth year, but the figures for 1940 are not yet available. The results for 1939 just failed to reach statistical significance on the 20 :1 basis of probability. The NPK mixtures appeared to have given the best result and the NP mixture the poorest, apart from the control plots. Differences in the figures for dry rubber content of the latex, and for bark renewal were not significant, but there is an indication that the application of phosphates may lead to a reduction in dry rubber content and a small improvement in the rate of bark renewal. The usual report on the experiment was published in the Quarterly Circular.

Measurements in the manuring experiment in young replanted Rubber at Dartonfield (Areas No. 2 and 2A) were made in June when the plants were two years old. The differences between the nine manurial treatments were not significant but the complete mixture had given the best

apparent result. Examination of girth increment figures for a period of nine months showed a small significant response to phosphates and a non-significant response to potash. There was no difference in the results according to whether cover crops were forked in with the manures or mulched on the surface.

A comparison of the effects of manuring with organic and inorganic fertiliser mixtures of equal nutrient content is included in planting experiment No. 3 at Dartonfield (1936). Differences in girth at the age of 4 years were not significant, but the increment figures for the year showed a small significant difference in favour of the inorganic mixture. It is of considerable practical interest to know that the more expensive organic mixture has shown no better results than the inorganic mixture during a 4-year period.

A small trial was undertaken in replanted Area No. 4 (1939) to compare frequent applications of a soluble readily available manure (inorganic) with one less readily available (organic), and to study the effect of adding minor elements to the soluble mixture. After 18 months there was a significant response to the organic mixture and an almost significant response to the inorganic mixture. The lack of response to the mixture containing minor elements suggested the possibility of an inhibiting effect. The experiment is being continued in a modified form.

The comparison of compost with an artificial fertiliser of corresponding nutrient content, which was started in 1937 in the 1935 clearing at Nivitigalakele, was continued. The series of measurements made in 1940 revealed only very slight differences in the size of the trees and the girth increases during 12 months. The trial comprises 38 comparisons in plots of 12 trees, each planted with a different clone.

In the 1940 clearing at Nivitigalakele a study was made of the effects of adding P, K, and PK in the planting holes. Girth measurements of budded stumps, approximately 13 months after planting, showed a significant increase of about 18% in the P plots. It is suggested that the lack of response to K may be due to the ample supply of this nutrient in the form of wood ash.

A swamp area of 3 acres at Nivitigalakele, which was previously utilised as a budwood nursery, was replanted with illegitimate clonal seedlings in 1940, and is being utilised for a trial to study the fertiliser requirements of the white soil which occurs in this type of land. The first applications of manure were made shortly after planting.

Manurial trials in young replanted areas were started in a number of estates in 1938, on lines recommended by the Research Scheme. Measurements were received from 12 estates in 1939 and the number was reduced to 7 in 1940. There were small significant responses to manuring in 3 instances. A more comprehensive trial is in progress

on an estate in the Matale district, where the layout of the area involves 27 treatments each replicated four times. Up to the present there has been no response to manuring, .even at a relativley high rate of application.

Two experiments dealing with the manuring of nursery plants were undertaken during the year. In the first trial N (2 levels), P and K. separately and in all combinations, were compared. Measurements were made at the age of 10 months; the results, when treated factorially, show a small but significant increase in growth due to N, and small but significant depressing effect due to K. In the second trial the effects of four different forms of nitrogen were studied. The differences in growth were not significant but nitrate of soda showed an apparent inferiority to the other fertilisers. The general level of growth in the nurseries was poor, possibly due to very dry conditions shortly after planting, and to an attack of 'Birds' eye spot" later in the year.

Generally speaking, the response of young Rubber to manuring, as indicated by the trials in progress, has been distinctly disappointing. So far it is only with phosphate that a reliable indication of response has been obtained, but it is considered prudent, until further evidence is available, to continue to recommend the use of an N.P.K. mixture (with K as the minor constituent) in young replanted areas.

Soil Survey and Analysis.—Thirteen soil profiles were examined on estates, and 183 soil and other samples were dealt with in the laboratories.

SMALLHOLDINGS DEPARTMENT.

The Smallholdings Propaganda Officer reports that the services of his department have been utilised to a markedly increased extent during the year. This is attributed partly to a growing recognition of the value of the services offered, and partly to the comparatively prosperous state of the industry, which enabled smallholders to give more attention to the improvement of their holdings. The price of rubber on the local market was in the neighbourhood of 50 cents per lb. throughout the year, and the relatively low price of coupons provided an incentive to smallholders to tap their trees regularly.

The staff of the department consists of six Rubber Instructors (stationed at Horana, Matugama, Galle, Ruanwella, Katugastota, and Ratnapura), and a Clerk Translator. It was decided to divide the Ruanwella range and appoint an additional Instructor; an appointment was pending at the end of the year. The Smallholdings Committee of the Board inspected the Ratnapura, Galle, Matugama and Ruanwella ranges during the year and expressed satisfaction with the work in progress. An informal visit to the Matugama range was also made by the Hon'ble the Minister for Agriculture and Lands.

Competitions for the "best-kept holding" were organised in all the ranges except at Galle, where the competition was abandoned owing to lack of support. Judging was undertaken by the Smallholdings Propaganda Officer, assisted in the Horana range by the Acting Director and Mr. W. P. H. Dias. Improvements in sheet making, soil conservation, tapping etc., were reported to be very satisfactory, particularly in the Horana range. In addition to the usual cash prizes a special prize was offered by Mr. W. P. H. Dias, one of the members representing smallholders on the Research Board, for the best smoked sheet in the Kalutara district. Formal prize-givings were held in respect of the competitions in the Horana, Matugama, Ratnapura, and Ruanwella ranges. The Government Agent presided at Horana and Ratnapura meetings, and the prizes were distributed by the Director. Addresses were given by the Smallholdings Propaganda Officer on subjects relating to the work of the department.

Apart from the general shortage of coagulants in the early months smallholders experienced considerable difficulty in obtaining supplies of good quality acid at reasonable prices throughout the year. The trouble appeared to be partially due to a tendency for Colombo dealers to reserve stocks for their larger customers, but was mainly attributed to profiteering on the part of local dealers. In some instances the acid on sale was of satisfactory quality but unduly expensive, in others it was diluted with water or contaminated with sulphuric acid. Proprietary coagulants, usually consisting of diluted sulphuric acid, were also on sale at prices which were far above their proper value. The problem of dealing with these difficulties was discussed with the Food Controller and Controller of Prices, at an interview attended by the Director and the Smallholdings Propaganda Officer. The subject was further reviewed by the Smallholdings Committee early in January, 1941, and their recommendations (which were later endorsed by the Board) are included in this report in order to bring the subject up to date. They are as follows :—

(1) To recommend (as has been done in Malaya) that regulations be issued prohibiting the import of sulphuric acid, and other mineral acids, except under permit.

(2) Rubber Instructors to persuade village dealers to stock acid supplied by firms whose product is known to be satisfactory, and advise smallholders to buy their acid from dealers who do so.

(3) To recommend that steps be taken to have stocks of acetic and formic acid brought under control while stocks are plentiful, in order that price or other restrictions could be imposed without delay in the event of a shortage developing at any time.

Proposals for undertaking work, jointly with the Co-operative Department, for the benefit of Rubber smallholders received consideration. The Registrar thought there was considerable scope for the formation of Co-operative Credit Societies and suggested that a trained officer from his department should be assigned to undertake special work in this direction at the expense of the Research Board. It appeared preferable to make a trial by forming a single Society in the first place, and discussion is proceeding regarding the best way to implement the desire of the Research Board and the Co-operative Department that the possibilities of co-operative work should be given a thorough trial. One of the Rubber Instructors arranged for the purchase of acetic acid by several local co-operative societies; this resulted in substantial savings to the members.

A fair amount of replanting was done by smallholders in spite of the natural tendency for the high price of the commodity to discourage them from removing tappable trees. The general advice of the Research Scheme was that only poorly grown or badly overtapped areas should be replanted under present conditions. Assistance was given by the Instructors in the replanting of about 245 acres. About 7,000 budded stumps and 2,000 yards of budwood were sold to smallholders during the year; much of this material, however, was used for new planting as distinct from replanting.

The demonstrational replanted areas in the different ranges were maintained in good order. Girth measurements, which were made towards the end of the year, indicated a very satisfactory level of growth, especially considering that the areas are small and over-shaded on two or more sides, and have not received any artificial fertilisers.

Budding demonstrations were given in the nurseries established in the ranges, and facilities were provided for learners to practise the work. New nurseries were established where required, and assistance was given to smallholders in the opening of 14 private nurseries. Three courses of training in budgrafts were held for smallholders at Nivitigalakele. Other demonstrational field work undertaken by the Instructors related to compost making, tapping, disease treatment, etc. A useful tabulated summary of their activities is given in the Smallholdings Propaganda Officer's report.

There was an increased demand for the assistance of the Instructors in the construction of the small smokehouses which are recommended by the department. 109 smokehouses were started during the year and 82 completed. Fourteen demonstration smokehouses were also constructed by the department in villages where they have not yet been popularised. The design of a smokehouse to hold 800 lbs. was prepared by the Chemist, to meet the requirements of rather larger Rubber owners, or groups of smallholders. Designs are now available

for a range of inexpensive buildings to hold 18, 120, 350, and 800 lbs. of rubber respectively.

Efforts were continued to improve the quality of smallholders' sheet by means of demonstrations, the competitions already referred to, the distribution of leaflets, and individual advisory work. 104 sheet-making demonstrations were given during the year. Monel metal mesh for straining latex was sold to smallholders at a specially low rate to popularise its use. One of the main handicaps to the progress of the work of improving manufacture is the fact that the great majority of local dealers still purchase the rubber on an ungraded basis. Co-operative marketing would lead to a better price being obtained for sheet of improved quality, and it is hoped during 1941 that the Commissioner for Agricultural Marketing will be able to give a trial to the previously discussed scheme for appointing local agents who are prepared to purchase village rubber on a graded basis.

A coloured poster illustrating the advantages of replanting was issued early in the year and is serving a useful purpose in drawing general attention to the work of the department. Three leaflets, dealing with Replanting, Budding, and Preparation of Smoked Sheet were revised and reprinted; there has been a greatly increased demand for these publications. The department participated in one local exhibition during the year.

DARTONFIELD ESTATE.

Crop for the year amounted to 65,500 lbs. representing a yield of 546 lbs. per acre, and was 4,500 lbs. short of the estimate. The shortfall may be partially attributed to weather conditions which, as in the previous year, included very dry weather in the early months and unseasonable rain in the latter part of the year. Apart from the effect of these factors, however, it is considered that the estimate was rather higher than the present yielding capacity of the property.

Approximately ½ the crop was marketed as crepe, ¼ as smoked sheet, and ¼ as preserved latex (38/40% and 58/60%). Latex purchased from an outside estate increased the preserved latex output to 12½ tons (dry rubber).

Tapping was continued on the 2S 2, d 4, 100% ("double-four") system which was adopted when the estate was purchased in 1933 and appears to be quite satisfactory under the prevailing conditions.

Oidium leaf disease caused very little damage and the foliage, in common with that of other estates in the district, was the best which has been seen for some years. One complete and 3 partial rounds of sulphur dusting were carried out. A limited amount of secondary leaf-fall occurred in parts of the estate during the S.W. Monsoon. Fifteen cases of root disease were reported in the mature area and 6 cases in

replanted areas. Ten trees were blown down during heavy storms in May, which caused extensive damage in other parts of the district.

A good cover of Pueraria was maintained in most parts of the estate. Selective weeding and clearing of boundaries were carried out as required.

Half the estate was manured with an inorganic mixture in accordance with the usual programme of biennial manuring. Manuring of replanted areas was undertaken according to experimental requirements.

Labour conditions were satisfactory during the year, except for a temporary shortage of tappers during the September harvesting season. The policy which is followed is to employ Ceylonese labour wherever possible without, however, dispersing the established force of non-Ceylonese labourers. Several Ceylonese families are now resident on the estate and it is intended to encourage further settlement in 1941 by providing improved quarters. Average daily out-turn of labour during the year was as follows :—

Ceylonese	...	...	28
Non-Ceylonese	...	...	21

There was a relatively severe outbreak of Malaria in May, in spite of periodical oiling of streams on the estate, and spraying of living quarters. The Medical Officer of the Malaria Control Scheme, who reported on the outbreak, considered that it was probably due to mosquitoes breeding in a stream beyond the estate boundary.

The Visiting Agent, Mr. P. R. May, inspected Dartonfield and Nivitigalakele on 4th May and 19th November. Both his reports were satisfactory.

NIVITIGALAKELE.

Crop for the year amounted to 26,000 lbs. compared with an estimate of 25,000 lbs., representing an average yield of 414 lbs. per acre. The level of yield at Nivitigalakele is sometimes commented on by critics as being a "poor advertisement for budded Rubber." It would, however, be surprising if high average yields were obtained from a collection of untried clones, which was established for the purpose of selecting clones suitable for commercial planting. Records of the two clones which have been recommended for extensive planting as a result of the trials provide a better indication of the potentialities of budded Rubber. Crop from commercially tapped areas was marketed as smoked sheet (70%); test-tapping biscuits and scrap were milled at Dartonfield and marketed as blanket crepe.

Attacks of Oidium leaf disease and secondary leaf-fall were very slight. No cases of root disease were reported. A few trees were lost by wind damage, and some unproductive trees were removed.

The usual annual application of manures was made in the areas planted in 1926, 1927 and 1928. One application was made in the 1935 clearing, except in the part allotted to the "compost trial" which received two applications in accordance with experimental requirements. Two applications were made in the 1939 clearing; nurseries were manured according to schedule.

There was a considerable improvement in the growth of buddings in the 1935 clearing. Average girth of budded stumps at 5 years was 13.8 inches, respresenting an increment of 3.8 inches for the year. Part of the seedling area is already in tapping and several clones will be tapped in 1941. The average height of budded stumps in the 1939 clearing was 6.5 ft. at the age of 12 months.

An area of 10 acres was cleared on the "no burn" system and utilised for a clone trial. The planting season was a favourable one and the plants were growing well at the end of the year. A description of the method of opening was given by the Estate Superintendent at the Rubber Conference held in April. So far as can be judged at present the system appears to be well suited to local conditions. Preliminary operations were undertaken towards the end of the year for opening a further 14 acres on the same lines.

Approximately 5,000 yards of budwood and 4,000 budded stumps were supplied from the Nivitigalakele nurseries during the year. Ten courses of training in budgrafting were held and 104 students attended.

WAGOLLA.

Test-tapping was continued and a crop of approximately 12 lbs. per tree was obtained from the 187 trees in tapping.

The usual monthly visits were made by the Nivitigalakele Conductor and the Estate Superintendent made 2 visits during the year.

ADVISORY SERVICES ETC.

Co-operation was maintained with the Chief Advisory Officer of the New Rubber Planting Scheme, and advice on matters connected with new planting was given to a number of capitalist permit holders. The Manual of Rubber Planting (referred to in last year's report) was published by Government; copies of the manual were made available to the Research Scheme, without charge, for distribution to persons registered to recieve the Scheme's publications. Advice was given to Government on the upkeep of its budwood multiplication nurseries, and further quantities of budwood were supplied for use in the nurseries.

Enquiries on agricultural subjects were largely concerned with the choice of planting material; increased interest was shown in the possibilities of using clonal seed. Enquiries regarding tapping systems showed an increase over the previous year. On the subject of manuring many of the enquiries related to the use of substitute mixtures, arising from the scarcity of certain ingredients owing to the war. The Botanist reports an encouraging increase in the number of enquiries from Ceylonese proprietors and superintendents.

There was a marked increase in the advisory work of the Chemical Department during the year. Reference has already been made to work arising from the shortage of coagulants; shortage of aluminium and packing materials also led to a number of enquiries. Interest in modern methods of manufacture was more active than in previous years, doubtless owing to the more prosperous condition of the industry; the premium on smoked sheet in the Colombo market also led a number of estates to consider a change-over from crepe to sheet manufacture. Several warm air drying houses, of the type recommended by the Research Scheme, were constructed on estates during the year, including one to deal with an annual crop of 2½ million pounds. A tunnel type smokehouse, as designed by the Rubber Research Institute of Malaya, was constructed on a local estate under the guidance of the Research Scheme. More buildings of this type are likely to be constructed during 1941.

It was decided that the "Planting Memoranda" which have been prepared from time to time to facilitate advisory work, should form the nucleus of a series of "Advisory Circulars," and that future circulars should be issued without charge to persons registered to receive the Scheme's publications. The existing memoranda were printed as Advisory Circulars No. 1—13, and 2,725 copies were sold during the year at 25 cents each. One new Circular ("Rat Control") was issued.

Advisory visits were made to estates during the year as follows:—

Botanical and Mycological Department	...	26
Soils Department	...	2
Chemical Department	...	20

The Conductor, Nivitigalakele, visited 2 estates for the purpose of checking the identity of planting material.

There were 107 visitors to Dartonfield during the year according to the Visitors' Book, which usually does not provide a complete record. A party of 23 students from the School of Agriculture, Peradeniya, also visited the estate. Among notable visitors were:—

Mr. J. D. Manning of the U.P.A.S.I. Tea Experiment Station; Dr. P. J. S. Cramer; Mr. C. B. Bogardus, Goodyear Tire & Rubber Co.; Mr. F. C. Gimson, Controller of Labour; Mr. W. E. Hobday, Government Agent, Western Province; Mr. P. J. Hudson, Assistant Government Agent, Kalutara.

MEETINGS, COMMITTEES, ETC.

The Director or Acting Director attended meetings of the Rubber Research Board by invitation, and served on the Experimental Committee, the Smallholdings Committee and the Provident Fund Committee.

The Director is an *ex-officio* member of the Central Board of Agriculture.

Rubber Conference.

A successful and well attended Rubber Conference, organised by the Planters' Association of Ceylon, was held in Colombo on April 19th. Arrangements were made by a Committee on which the Ceylon Estates Proprietary Association and the Rubber Research Scheme were represented, and these two bodies contributed jointly with the Planters' Association towards the running costs. The Conference was opened by the Hon'ble Mr. D. S. Senanayeke, Minister for Agriculture and Lands. Three papers were contributed by officers of the Research Scheme, and the Acting Director summed up the discussions on all papers. A Field Day arranged at Dartonfield on the day following the conference proved a complete fiasco as only two visitors turned up. Papers and addresses were given by Research Officers at the conference and elsewhere as follows :—

The Maintenance of Soil Fertility in Young Rubber Clearings—L. A. Whelan.

Planting Material — C. E. Ford.

Tapping Young Budded Trees — R. K. S. Murray.

Southern Province Planters' Association :—

Some Aspects of the Manuring of Mature Rubber — L. A. Whelan.

Planters' Association of Ceylon (General Committee) :—

Coagulating Acid from Coconut Shells—M. W. Philpott.

CO-OPERATION WITH OTHER RESEARCH ORGANISATIONS.

The Director attended a meeting of Directors of Rubber Research organisations in the East, which was held at the Headquarters of the Rubber Research Institute of Malaya on February 26th. The meeting had been convened by the Chairman of the Institute for the purpose of discussing possible arrangements for co-operation between, and the co-ordination of the work of, the organisations. Valuable recommendations were made but it is uncertain whether they can be put into full effect under the present unsettled conditions.

The opportunity was taken to see and discuss the work in progress at the Institute, and to visit a limited number of estates in Malaya. Short tours were also undertaken in Java and Sumatra, and visits were made of the Rubber Proefstation, Buitenzorg, Java, and the General Proefstation der A.V.R.O.S. at Medan, Sumatra. The writer wishes to express his sincere thanks to the Directors of the Institutes and to Estate Managers and others in the three countries for the cordial welcome which he received during his tour.

Apart from this visit the usual close co-operation was maintained with the Rubber Research Institute of Malaya by the exchange of reports, and by correspondence between the officers of the two Institutes. An exchange of clones was effected with the Rubber Proefstation, Java, and the Proefstation der A.V.R.O.S., Sumatra.

While on leave in England the Director met the staff of the London Committee for Rubber Research (Ceylon and Malaya) on several occasions, and discussed the work in progress at the Imperial Institute and at Dartonfield. Meetings of the London Advisory Committee, the Technical Sub-Committee, and the Standardisation Sub-Committee were also attended. Visits were made to the laboratories of the British Rubber Producers' Research Association and the Research Association of British Rubber Manufacturers, and to Rothamsted Experiment Station. Attendance at a Rubber Conference in Paris was prevented by the military situation.

Reports were exchanged with the British Rubber Producers' Research Association and the Rubber Growers' Association. Co-operation was maintained with the Tea Research Institute and the Coconut Research Scheme on subjects of common interest.

Publications were exchanged with scientific organisations in different parts of the world.

PUBLICATIONS.

Publications of the Research Scheme are issued without charge to the Proprietors (resident in Ceylon), Superintendents and Local Agents of Rubber estates over 10 acres in extent, who apply for registration. Extra copies are supplied for the use of Assistants on large estates. Particulars of issues of publications are given below :—

		1940	1939
Estates and Agencies	...	761	735
Subscribers	...	47	51
Exchange List	...	54	60

Publications issued during the year were as follows :—

Report of the Work of the Rubber Research Board in 1939.

1st Quarterly Circular, 1940—

Ceylon Clones—VIII (1939). C. E. Ford.

Field Experiments on Dartonfield Estate—XI. Manuring Experiment with Mature Rubber (1939). L. A. Whelan and C. A. de Silva.

Time of Tapping and the Large Task. A. H. Healey.

War-time Coagulants. A note on Proprietary Substitutes. M. W. Philpott.

Replanting in Areas infested by Root Disease.

2nd Quarterly Circular, 1940—

Proceedings of the Rubber Conference, April 19th.

3rd Quarterly Circular, 1940—

Field Experiments on Dartonfield Estate—XII. Comparison of Tapping Systems. R. K. S. Murray & C. A. de Silva.

The Performance of Imported Clones in Ceylon—IV. C. E. Ford.

Some Aspects of the Manuring of Mature Rubber. L. A. Whelan.

The International Notation for Tapping Systems (Revised Version : May, 1940).

4th Quarterly Circular, 1940—

Field Experiments on Dartonfield Estate—XIII. Measurements of Growth in Replanted Areas. L. A. Whelan and C. A. de Silva.

Manuring under War Conditions. L. A. Whelan.

Packing Raw Rubber. M. W. Philpott.

Planting Notes.

Advisory Circular No. 14—

Rat Control.

(Sgd.) T. E. H. O'BRIEN,
Director.

Research Laboratories,
Dartonfield,
Agalawatta,
7th March, 1941.

REPORT OF THE CHEMIST FOR 1940

STAFF AND ORGANISATION.

The Chemist, Mr. M. W. Philpott, was in charge of the Department during 1940, but was frequently away for short periods on military duty. These absences necessarily interfered with the progress of experimental work during the year.

One Laboratory Assistant, out of an establishment of two, resigned his post towards the end of the year after having been absent on sick leave since the beginning of September. The remaining Laboratory Assistant, Mr. N. Palewandrem, was primarily occupied with the routine physical testing of rubber samples.

At the time of writing the Chemist is under orders to hold himself in readiness to leave Ceylon at short notice in order to take up military duties abroad.* Consequently it has not been possible to devote so much time as in previous years to the preparation of the annual report. The record of the work of the department during 1940 is therefore less detailed than usual; the only investigation which is reported at length being the one on variability in raw rubber.

LATEX.

Latex Shipment.—For several years reference has been made in this report to the growing importance of latex as an industrial raw material. Latex production has been advocated and demonstrated by the Rubber Research Scheme since 1935, but up to the present rubber producers themselves have shown little interest.

During the year under review particular attention was given to the production of normal and creamed latex for the Indian market. Towards the end of the year far more orders for latex were being received from India than could be supplied with the limited facilities available at Dartonfield. There was abundant evidence to show that Ceylon producers, if they wished, could develop a valuable latex trade with India, and it was considered that a renewed campaign of publicity might meet with some response.

Accordingly a letter was sent in August to the Ceylon Estates Proprietary Association, the Low-Country Products Association of Ceylon and the Planters' Association of Ceylon drawing attention once more to the

* These orders were subsequently cancelled.

existence of a demand for latex in India, and pointing out that if Ceylon estates continued to ignore the latex trade, the opportunity of developing this attractive potential market would undoubtedly pass to more progressive rubber producing countries. The letter drew enquiries from one or two estate managers who were interested, but the general response was disappointing.

Latex Concentration.—As latex centrifuges are almost unobtainable under war-time conditions, work on latex concentration was confined to the creaming process.

Creaming Agents.—In anticipation of difficulties in importing supplies of the usual creaming agents (such as tragon seed gum which is of Mediterranean origin) attention was given to the possibility of utilising local materials instead. Gum tragacanth from India and tamarind seed gum from the locally grown *Tamarindus indica* are possible alternatives. Many grades of Indian gum tragacanth were tested and found to be very variable in their creaming properties. Tamarind seed gum, an efficient creaming agent, gave promising results and its properties were studied in some detail. In the past the main objection to Tamarind seed gum has been the difficulty of completely separating the seed gum from the insoluble husk. Some progress towards the solution of this problem had been made at the end of the year but a practical method of preparation had not been fully worked out. It may be noted, however, that a 3 per cent gum solution, prepared by boiling the ground dehusked seeds with water, can be effectively clarified by centrifuging. Other points of practical interest established by these trials were :—

(1) The creaming properties of the gum solution remained unimpaired when kept for a period of several weeks in the presence of a small proportion of ammonia. (2) For efficient creaming the best proportion of gum was found to be 0.25 per cent to 0.30 per cent calculated on the water phase. (3) No improvement in creaming was secured by increasing the proportion of ammonia in the latex beyond the minimum that is required for efficient preservation during the creaming period.

Delayed Ammoniation.—It has been claimed that the creaming capacity of latex is improved if ammoniation is delayed as long as possible. The practical risk involved in utilising this observation is obvious, but it seemed worth while to see (a) whether delayed ammoniation does improve creaming capacity, and if so (b) whether this principle can be safely adapted to estate practice by treating the latex first with a bactericide (or temporary preservative) and then adding ammonia after the lapse of a suitable period.

From a large number of creaming trials with Dartonfield latex it was concluded that delayed ammoniation resulted in a real increase of between 1½ and 2 per cent in the D.R.C. of the cream. On normal tapping days field latex could be kept until 3 p.m. before ammonia was added. Latex temporarily preserved with 0.1 per cent of sodium arsenite or sodium cyanide could safely be kept for 24 hours before ammoniating, but it was found that 6 hours (*i.e.*, until 5 or 6 p.m.) was sufficient to effect a maximum improvement in creaming properties. A point of interest is that the delay in ammoniation had no effect on the creaming properties when the latex was creamed in the presence of 0.3 per cent of soap. It seems probable, therefore, that the change which occurs in unammoniated latex during the first few hours after collection is equivalent to the addition of a small proportion of soap. As the addition of soap would be a simpler and safer method of improving creaming capacity, the method of delayed ammoniation is not likely to be of practical value except, possibly, on estates where the latex possesses unusually poor creaming properties, or where the use of soap is for some reason undesirable. The use of poisonous preservatives might also be objected to by consumers.

VARIABILITY OF RAW RUBBER.

This subject has again taken a prominent place in the work of the department during 1940. The preliminary work of previous years is now beginning to bear fruit, and the data now accumulating should form a valuable basis for future work.

Variability of Ceylon Estate Rubber.—Early in the year all estates with an acreage of about 1,000 acres and over were asked to submit samples of their normal estate produce and to supply certain details of manufacture. The total number of estates circularised was 78 of which 72 responded. The produce of these estates amounts to nearly one-third of Ceylon's estate rubber, or to one-fifth of the Island's total production. It is of interest to note (Table I) that the majority of the largest Ceylon estates manufacture crepe as opposed to smoked sheet.

From the details of manufacture submitted with the samples it was possible to extract information on the estate to estate variations in factory methods. Where the departure from normal practice was very marked, the estate manager concerned was advised to review his procedure.

The rubber samples were all vulcanised in the standard accelerated test mixing ("AM") for 60 mins. at 127°C, and in the standard rubber-sulphur test mixing ("RS") for 120 mins. at 148°C. Hardness (D'_{30}) was also determined.

TABLE I

Survey of Estates Larger than 1,000 Acres.

Number circularised	...	...	78
Number of responses	...	...	72
No reply	...	...	6

Form of Manufacture	No. of Estates	Aggregate acreage acres	Aggregate Standard Assessment (approx.) tons
Crepe ...	57	82,600	17,500
Smoked Sheet ...	10	10,500	2,000
Crepe & Smoked Sheet ...	5	5,300	1,200
Total ...	72	98,400	20,700

In Tables II and III are shown the mean values of the properties determined and their dispersions.

TABLE II

Crepe and Smoked Sheet.

No. of estates	...	...	72
No. of samples	...	...	77
Aggregate acreage	...	...	98,400 acres.
Aggregate standard assessment (approx.)			20,700 tons.

	D_{30}	AM Mixing		RS Mixing	
		T_7 Kg. per sq. cm.	B Kg. per sq. cm.	T_8 Kg. per sq. cm.	B Kg. per sq. cm.
Mean ...	1.52	45.3	145.8	62.8	146.9
Range ...	1.39 to 1.64	26 to 82	102 to 179	40 to 122	105 to 168
Std. deviation ...	0.09	10.2	19.7	15.8	12.9
Coefficient of variation ...	5.9%	22.5%	13.5%	25.2%	8.8%

Histograms showing the distribution of modulus in both test mixings are reproduced in Fig I. The 77 rubbers are here treated as a single sample irrespective of the form of manufacture.

TABLE III

Crepe

No. of estates	... ...	57
Aggregate acreage	... ...	82,600 acres.
Aggregate standard assessment (approx.)		17,500 tons.

	D_{30}	AM Mixing		RS Mixing	
		T_7 Kg. per sq. cm.	B Kg. per sq. cm.	T_8 Kg. per sq. cm.	B Kg. per sq. cm.
Mean ...	1.52	43.3	145.1	58.7	146.1
Range ...	1.41 to 1.64	26 to 59	116 to 176	40 to 90	119 to 168
Std. deviation ...	0.09	8.1	20.0	11.8	11.3
Coefficient of Variation ...	5.9%	18.7%	13.8%	20.1%	7.7%

In view of the small number (15) of estates which supplied smoked sheet it was considered desirable to increase the number of smoked sheet samples by including 16 additional estates smaller than 1,000 acres. The properties of the 31 samples of sheet are summarised in Table IV.

TABLE IV

Smoked Sheet

No. of estates	... ...	31
Aggregate acreage (approx.)	...	23,500 acres.
Aggregate standard assessment (approx.)		5,000 tons.

	D_{30}	AM Mixing		RS Mixing	
		T_7 Kg. per sq. cm.	B Kg. per sq. cm.	T_8 Kg. per sq. cm.	B Kg. per sq. cm.
Mean ...	1.48	50.4	145.1	72.7	142.0
Range ...	1.27 to 1.66	30 to 82	102 to 179	42 to 122	105 to 162
Std. deviation ...	0.07	12.1	19.7	20.0	16.3
Coefficient of Variation ...	4.9%	24.0%	13.6%	27.5%	11.5%

The significance of these results can best be judged by examining them in conjunction with similar data collected elsewhere. Only by the accumulation of such data can it be hoped to establish standards of uniformity and limits of tolerance for raw rubber.

The fact that crepe is the most usual form of manufacture for large Ceylon estates must be allowed for in comparing the Ceylon figures with those collected in Malaya* and in the United States of America† where only smoked sheet has been subjected to this type of survey. Crepe may be expected to exhibit lower modulus values and less variation than smoked sheet, and this is borne out by the mean values and the standard deviations shown in Tables III and IV.

In the Malayan survey referred to, the mean modulus (T for 157 samples of estate smoked sheet was 52 kg. per sq. cm. and the standard deviation 12.27 kg. per sq. cm. The corresponding values for Ceylon sheet (See Table IV) were 50.4 and 12.1. The remarkable agreement is doubtless fortuitous, but in view of the fact that the testing methods employed by the Rubber Research Institute of Malaya and the Ceylon Rubber Research Scheme are known to give almost identical results, it is justifiable to conclude that there is no important difference between Ceylon and Malaya in regard to the vulcanising properties and the variability of their estate rubber. Though this result is not unexpected, it establishes the important point that a set of standards of uniformity which is suitable for Malaya is likely to be equally suitable for Ceylon.

Variability of Dartonfield Estate Rubber.—The commercially tapped areas at Dartonfield were planted in 1910-1912 and are now tapped on the "double four" (2S/2, d/4, 100%) system. Monthly examinations of the estate's standard crepe and smoked sheet were initiated early in 1939 with a view to estimating the extent of the variation which is liable to occur in the rubber from a single estate. Table V shows the monthly changes in the vulcanising characteristics of the rubber, the properties recorded being the modulus in the two standard test mixings.

Several points of interest emerge from these results. In the first place Dartonfield rubber is seen to be exceptionally slow curing (low modulus). In the survey of estates referred to in the last section, the mean value for the modulus (T_7) of smoked sheet was found to be 50.4 kg. per sq. cm. and the standard deviation 12.1 kg. per sq. cm. The average value for Dartonfield sheet from Table V is 36.6 which means, on the normal statistical theory, that only one estate in about eight is likely to produce smoked sheet which cures as slowly as Dartonfield sheet. Secondly, while crepe remained substantially uniform throughout the year, smoked sheet showed a slight but well defined variation when tested in the accelerated mixing but not in the rubber-sulphur mixing

* *J.R.R.I.M.*, 1939, **19**, 200. † *I.R.W.*, June, p. 53.

Fig. 1

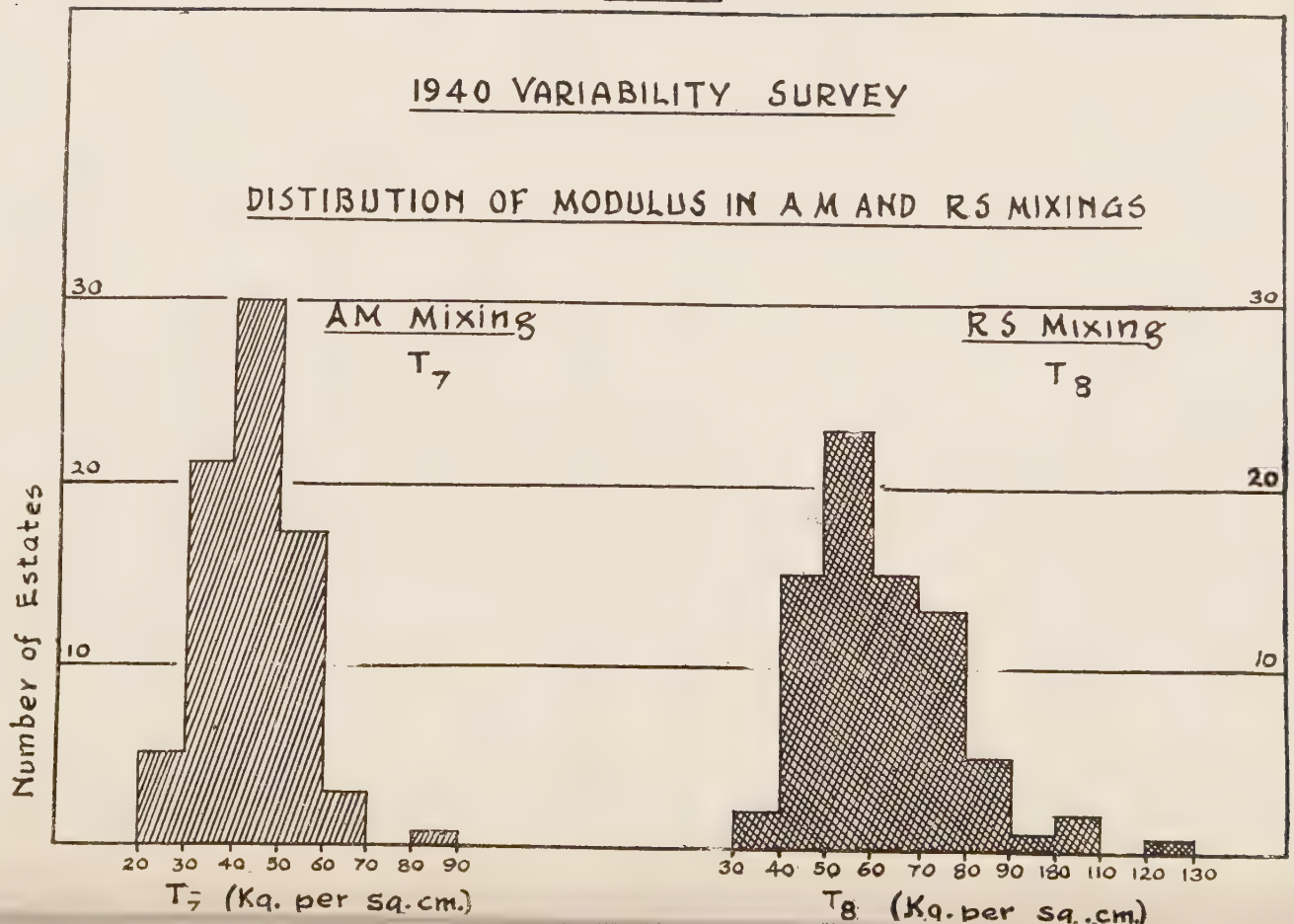
1940 VARIABILITY SURVEY
DISTIBUTION OF MODULUS IN A M AND RS MIXINGS
AM Mixing
T_7
RS Mixing
T_8
Number of Estates
30
20
10
20 30 40 50 60 70 80 90
T_7 (Kg. per sq.cm.)
30 40 50 60 70 80 90 100 110 120 130
T_8 (Kg. per sq.cm.)

TABLE V

Seasonal Variations in Dartonfield Rubber.

Month	Crepe		Smoked Sheet	
	AM Mixing T_7 — kg. per sq. cm.	RS Mixing T_8 — kg. per sq. cm.	AM Mixing T_7 — kg. per sq. cm.	RS Mixing T_8 — kg. per sq. cm.
June, 1939 ...	33	47	38	44
July ...	38	48	34	46
August ...	34	47	37	44
September ...	36	51	35	42
October ...	38	51	40	45
November ...	35	48	42	45
December ...	38	54	49	52
January, 1940 ...	36	46	42	49
February ...	—	No Tapping		—
March ...	29	43	27	46
April ...	36	45	27	43
May ...	31	50	32	39
June ...	37	52	33	47
July ...	34	48	36	47
August ...	39	49	38	45
September ...	38	48	34	44
October ...	31	52	30	50
November ...	39	52	40	45
December ...	41	61	45	51
From June, 1939 to May, 1940 — Mean	34.91	48.18	36.64	45.00
Range	29 to 39	43 to 54	27 to 49	39 to 52
St. Dev.	2.95	3.13	6.64	3.43
C. of V.	8.4%	6.5%	18.1%	7.6%

Smoked sheet may be expected from the nature of its preparation to exhibit more seasonal variation than crepe. What is surprising and contrary to experience in the figures for smoked sheet is that the variation is so much greater in the accelerated mixing (C. of V. 18.1%) than in the rubber-sulphur mixing (C. of V. 7.6%). It has generally been found in the past that the rubber-sulphur mixing is the more sensitive to variations in the rate of vulcanisation. One possible explanation of the present results may be found in the slow curing character of Dartonfield rubber; a misleadingly high variance might well be obtained if the standard cure of 60 minutes vulcanised the rubber only as far as the steep part of the modulus-time of cure curve where small advances in the time of cure result in relatively large increments in modulus. In comparing slow curing rubbers a truer estimate of differences in vulcanising properties might be obtained if the standard cure were lengthened so as to approximate more closely to the "optimum cure." This explanation is supported to some extent by the fact that when 100 minutes was taken as the standard time of cure a lower coefficient of variation (12.5%) was obtained. Even so the observed variation was greater than would be expected from the evidence of the rubber-sulphur mixing. It is conceivable that the variability factors operating within an estate may differ from those which operate between estates in such a way that the accelerated mixing is more sensitive in the one case than in the other.

Though the observed seasonal variations were slight, there was some evidence that the modulus rises to a maximum just prior to the period of defoliation and falls abruptly when wintering sets in.

It is generally believed that rubber prepared immediately after the wintering period of rest is abnormal. In the report for 1939 it was shown that crepe manufactured at Dartonfield in 1939 on the resumption of tapping after the wintering rest was unexpectedly normal. The tests were repeated in 1940, with the results shown in Table VI.

TABLE VI

Latex from which samples were prepared		AM Mixing T_7 — kg. per sq. cm.	
		Crepe	Smoked Sheet
Latex from preliminary tapping round		—	25
First estate collection after resting ...		36	34
Second estate collection after resting ...		39	30
Figures for previous eight monthly tests	Mean ...	36.0	39.6
	Range ...	33 to 38	34 to 49
	C. of V.	5.4%	12.1%

It will be observed that the rubber harvested on the resumption of tapping after the annual resting period was not abnormal in its vulcanising properties. The tendency was for the crepe modulus to be slightly high (confirming the 1939 results) and for the smoked sheet modulus to be slightly low. These conflicting tendencies, if real, are difficult to explain.

Influence of Tapping Systems.—The monthly tests on samples from the experimental tapping plots at Dartonfield show clearly the importance of the choice of tapping system on the uniformity of estate rubber. A detailed report on the subject must however be deferred for the present.

Clonal Rubbers.—Rubber from monoclonal blocks at Nivitigalakele and at an estate in the Kelani Valley were tested at regular intervals. The object of these tests is to determine the characteristic properties of the rubber produced by some of the newer clones which are being widely planted in Ceylon.

Influence of Methods of Preparation.—Lack of uniformity in factory methods is probably not a major factor in the total variation of estate rubber. Nevertheless it is well known that vulcanising and other properties do depend to some extent on manufacturing procedure. The question therefore arises whether it would be feasible for estates which now manufacture abnormal rubber to rectify the properties of their produce by suitably modifying their factory methods.

Investigations in the past have dealt mainly with the effect of applying single processing treatments, one at a time, in well designed factories which ordinarily produce normal rubber. It may be doubted whether the information so obtained is sufficient to enable one to foresee what would be the response to a combination of treatments operating on an abnormal latex under non-ideal factory conditions. For example, a treatment calculated to depress the rate of maturation, such as the addition of a disinfectant to the latex, might have little effect on the properties of sheet manufactured under good conditions, whereas the same treatment might have an important influence in a factory possessing an inadequate water supply or a badly designed smokehouse. For this reason it was decided to study the effect of simultaneously varying several processing factors, replicating the trials, if possible, on "abnormal" estates.

An experimental design well suited to this type of enquiry is the factorial design in which are included all combinations of the various treatments. Compared with the single factor type of experiment the factorial design should have the following advantages :—

(1) Treatments are examined in conjunction with several sets of conditions. Hence a positive response to any particular treatment is probably not restricted to a single set conditions.

(2) Where interactions between treatments occur, they are revealed in the analysis and can be further investigated.

(3) For a given expenditure of work the standard error is smaller in the case of the factorial experiment on account of the relatively large number of effective replications included for each treatment. In practice this may be a point of minor importance because the only treatments likely to be of value in the correction of abnormalities are those which produce a well marked response.

In order to test the suitability of the factorial design for factory experiments, two 2 × 2 × 2 trials relating to smoked sheet manufacture were undertaken at Dartonfield. There were two replications, each trial being carried out on two different days.

The factors studied in the first experiment were :—

(*a*) **Soaking the Wet Sheets.**—Part of the coagulum was rolled without water on the sheeting battery, the remainder being sprayed with water during rolling and then soaked for 2 hours in 5 changes of water.

(*b*) **Restricted Ventilation for Draining.**—Half the sheets were drained on an open verandah, and half in an enclosed unventilated space.

(*c*) **Delayed Smoking.**—Half the sheets were transferred to the smokehouse 6 hours after rolling, and half about 24 hours after rolling.

Only the main effects need be considered since the analysis of variance showed the interactions to be non-significant. The mean responses to the three treatments in terms of change in T'_7 for the 60-minute cure were as follows :—

(*a*) Washing and soaking	– 13.8	kg. per sq. cm.
(*b*) Restricted ventilation	– 2.5	,,
(*c*) Delayed smoking	+ 7.5	,,

The second experiment included the following treatments :—

(*a*) **Addition of an Antiseptic.**—Part of the bulked latex was treated with formalin at the rate of 1 c.c. per 1½ lb. sheet. To the remainder no antiseptic was added.

(*b*) **Delayed Coagulation.**—Half the latex was coagulated in the usual way within about an hour of arrival at the factory. The other half was standardised to 15% D.R.C. and allowed to stand for a further 3 to 3½ hours before the acid was added.

(*c*) **Delayed Smoking.**—As before half the sheets were put into the smokehouse 6 hours after rolling and half 24 hours after rolling.

Again no interactions were revealed by the analysis and the only effects to be considered are the main effects. The mean responses were found to be :—

(*a*) Antiseptic	– 7.5 kg. per sq. cm.	
(*b*) Delayed coagulation	+ 1.3 „	(Not significant)
(*c*) Delayed smoking	+ 4.8 „	

It will be recalled that Dartonfield rubber is very slow curing. The treatments included in the above trials would possibly produce a greater response if applied in the manufacture of sheet which ordinarily has a high rate of cure. It is intended that trials of this type should be extended in 1941 to other estates, particularly to estates where abnormally fast curing rubber is produced.

Influence of Smoking Conditions.—Differences in smoking conditions may result in large variations in vulcanising properties. This was very clearly brought out by an experiment in which wet sheet rolled at Dartonfield was distributed to twelve neighbouring smokehouses of various types. The resulting smoked sheets were examined together with samples of the standard produce of the twelve estates which co-operated in the experiment. The results of the tests are tabulated in Table VII. There were two replications, one trial being made in April and one in May. In Table VIII the results of the April trial are summarised in a manner which is designed to show what portion of the total variation between the twelve estate sheets is to be ascribed to differences in smoking conditions. From the values of the modulus (T_7) in the accelerated mixing it seems legitimate to infer that variation in smoking conditions may be one of the major factors in the total variation of estate smoked sheet. Smoking conditions appear to have rather less influence on the behaviour of the rubber in the rubber-sulphur mixing, while their effect on hardness (D_{30}) is negligible.

So far all attempts to correlate the properties of smoked sheet with the conditions prevailing in the smokehouse have failed, but it may be significant that the smokehouses which gave the lowest values for T_7 (A to E) in the above experiment were fired with jungle wood while all the other smokehouses (F to L) were fired with rubber firewood or with mixed jungle and rubber wood.

Scorching Test.—The scorching test described in Section VIII of the tentative "Specification for Testing Sheet and Crepe Rubber" compiled by the London Advisory Committee's Sub-Committee on Standardisation was

TABLE VII

Estate	Dartonfield Coagulum dried in Estate Smokehouse						Respective Estates' Standard Sheet dried during same period					
	Vulcanising Properties T_7 for 60′ cure kg/sq. cm.			Hardness D_{30}			Vulcanising Properties T_7 for 60′ cure kg/sq. cm.			Hardness D_{30}		
	April	May	Mean	April	May	Mean	April	May	Mean	April	May	Mean
A	28	28	28	1.38	1.38	1.38	30	32	31	1.45	1.36	1.41
B	27	30	28 (5)	1.43	1.49	1.46	33	34	33 (5)	1.27	1.37	1.32
C	31	35	33	1.45	1.39	1.42	40	52	46	1.50	1.45	1.48
D	33	37	35	1.44	1.34	1.39	46	49	47 (5)	1.47	1.48	1.48
E	35	37	36	1.46	1.47	1.47	67	64	65 (5)	1.66	1.60	1·63
F	33	39	36	1.42	1.36	1.39	35	39	37	1.43	1.34	1.39
G	34	39	36 (5)	1.44	1.42	1.43	58	70	64	1.49	1.49	1.49
H	38	36	37	1.42	1.41	1.42	51	51	51	1.51	1.46	1.49
I	36	44	40	1.45	1.46	1.46	46	56	51	1.42	1.44	1.43
J	39	44	41 (5)	1.40	1.41	1.41	52	49	50 (5)	1.54	1.51	1.53
K	37	51	44	1.45	1.41	1.43	47	57	52	1.52	1.49	1.51
L	48	53	50 (5)	1.44	1.39	1.42	58	75	66 (5)	1.48	1.41	1.45

TABLE VIII

	Dartonfield Coagulum dried in Estate Smokehouse (April series only)			Respective Estates' Standard Sheet (April series only)		
	D_{30}	AM Mixing T_7	RS Mixing T_8	D_{33}	AM Mixing T_7	RS Mixing T_8
		Kg. per sq. cm.	Kg. per sq. cm.		Kg. per sq. cm.	Kg. per sq. cm.
Number of Estates ...	12	12	12	12	12	12
Mean Value .	1.43	34.9	46.4	1.48	46.9	62.0
Minimum Value ...	1.38	27	39	1.27	32	42
Maximum Value ...	1.46	48	58	1.66	75	112
St. Deviation ...	0.023	5.53	5.44	0.082	13.3	17.3
C. of V. ...	1.63%	15.9%	11.7%	5.55%	25.4%	27.9%

examined critically prior to its adoption as a routine test. It was concluded that recovery figures for a single heating period are liable to be misleading, particularly if the heating period happens to coincide with the steep portion of the recovery-time of heating curve. Certain details of technique were found to have an important influence on the apparent scorching propensity of the sample under test; only by strict standardisation of procedure was it possible to obtain concordant results. At the end of the year a large number of Ceylon estate rubbers and clonal samples were being tested by the procedure that was finally decided on.

PURIFIED RUBBER.

In 1939 a small shipment of purified rubber (PR. 95) was sent to London for manufacturers' trials. The rubber was offered as a partially purified material which could be produced, if required, at short notice and at a cost not much above that of normal estate crepe. The method of preparation was to coagulate twice creamed ammoniated latex at a low concentration and to manufacture the coagulum as crepe in the ordinary way. No important difficulties were encountered and no specialised or unusual plant was used.

The tests made in London confirmed that the rubber had a moderately low water absorptive capacity, that it aged fairly satisfactorily and cured slowly.

The ageing properties of rubber prepared from alkaline latex are usually much inferior to those of ordinary plantation crepe or sheet. But there is evidence that when the multiple concentration process is applied to fresh unammoniated latex, the rubber retains its natural resistance to ageing almost unimpaired. Experiments during 1940 were mainly concerned with the possibility of purifying rubber on a production scale by centrifuging field latex. Though little progress was made in the development of a practical method of working, the trials yielded some interesting information about the behaviour of fresh, partially purified, unammoniated latex.

RUBBER COAGULANTS.

At the beginning of the year rubber producers of all classes were suffering from the shortage of normal coagulants which followed the dislocation of supplies at the outbreak of war. Many proprietary substitutes of doubtful quality were being used extensively and with little discrimination, and much of the Chemical Department's time during the first few months of the year was occupied in giving advice on alternative coagulants and in examining samples.

The imports of acetic and formic acids into Ceylon during 1940, were well in excess of current needs, being sufficient for the coagulation of nearly 120,000 tons of rubber. The actual quantities, according to the Ceylon Customs Returns, were :—

Acetic Acid	...	...	576 tons
Formic Acid	...	...	112 „

As the output of coagulated rubber during the year was about 80,000 tons, part of which was coagulated with sulphuric acid and other substitutes, it is reasonable to believe that the Island's stocks at the beginning of 1941 amounted to over six months' requirements.

Though the statistical position improved rapidly during the early part of the year, the smallholders' difficulties did not diminish at first because most of the incoming acid was allocated in advance to meet outstanding orders from estates. This aspect of the situation is dealt with more fully in the Report of the Smallholdings Propaganda Officer.

The managers of fifteen estates kindly recorded their experiences with the "re-use of serum" method of reducing acid consumption. On the whole the reports were disappointing. The saving in acid was stated in most cases to be negligible compared with the loss due to high percentage of off-grade rubber. Smoked sheet was generally slow drying, bubbly and variable in appearance while crepe tended to be mottled and slightly off-colour. Vulcanisation tests on Dartonfield rubber coagulated with the aid of serum showed that the rate of cure increased progressively with the age of the serum. Thus the uniformity as well as the appearance of the rubber is adversely affected by the re-use of serum. Under local conditions, therefore, the practical and technical objections to the method appear to be such that serum coagulation can only be recommended under exceptional conditions.

A number of estates had trouble in changing over from formic acid to acetic acid, and many samples of acetic acid were received at the laboratories for testing. It was found, however, that nearly every sample of alleged defective acid was satisfactory. It is thought possible that difficulties experienced in reverting to acetic acid are to be ascribed to the fact that acetic acid, possesses less pronounced antiseptic properties than formic acid, so that a higher standard of care and cleanliness is required if defects are to be avoided in smoked sheet manufacture. In some cases the difficulties complained of were traced to causes unconnected with the nature of the coagulant.

Advice was given to the Department of Industries on the local production of acetic acid from coconut shells, and samples from the department's experimental plant were tested from time to time.

Publicity was given to the coagulant position in a *communique* to the Press, in an article in the Research Scheme First Quarterly Circular, 1940, and in an address on "Coagulating Acid from Coconut Shells" read before the General Committee of the Ceylon Planters' Association in July.

THE PREPARATION OF CLEAN RUBBER.

It is satisfactory to be able to report that many estates were added during 1940 to the list of those that use the procedure recommended by the Research Scheme for the preparation of clean rubber.

Experimental work on the improvement of factory methods from the point of view of the cleanliness of estate rubber is handicapped by the lack of a satisfactory method of detecting minute quantities of foreign matter in rubber. Until such a test can be evolved estates must be recommended to adopt the latex settling procedure already specified, although it may be that this procedure is unnecessarily stringent. The main practical objection to the method of cleaning latex by settling is that the subsequent factory operations are inconveniently delayed. The difficulty can be partly overcome, as at Dartonfield, by fitting the settling tanks with floating outlet pipes or by multiplying the number of run-off pipes fixed at different levels. Nevertheless the problem is a real one and much importance is attached to its solution.

In the Research Scheme procedure, the recommended period of settling for latex standardised to 20% D.R.C. or less is 30 minutes for every foot of depth. As the minimum period for the effective removal of solid matter would vary if the viscosity of the latex varied, a series of tests extending over several months was made to see what differences occurred from day to day in the viscosity of 20% field latex. The viscosity at 30°C was found to approximate closely to 0.018 c.g.s. units and the variations from day to day were entirely negligible. It may be of interest to note that if this value for the viscosity is assumed to be correct, then the recommended period of settling should, on the basis of Stokes' Law, eliminate all particles of sand with a diameter larger than 1/15 mm. (1/400 inch).

PACKING RUBBER.

Following the receipt of a circular letter from the Colonial Office requesting rubber producers to discontinue the use of plywood chests for packing rubber, Colombo shippers were asked to state what methods of packing are normally employed by them. The writer is indebted to several shipping firms who invited him to visit their rubber packing departments. The information thus obtained may be summarised as follows :—

The greater part of Ceylon's Rubber is exported in sized hessian (or gunny) covered bales. An appreciable amount of smoked sheet is also packed in "bare back" bales. The proportion which goes forward in wooden chests cannot be stated accurately, but it is already small and is diminishing.

A short article on packing raw rubber was prepared for publication in the R.R.S. Quarterly Circular.

ESTATE MANUFACTURE.

At Dartonfield no changes of importance were made in estate manufacture. Crepe, smoked sheet and latex (normal and concentrated) were produced in the following amounts :—

Crepe	22,526 lbs.
Smoked Sheet ... ... -	17,233 „
Latex (normal and concentrated)	28,349 „

The type of warm air drying house which has been advocated for some years by the Research Scheme is now steadily gaining in popularity and several houses of this type were completed during the year. Of particular interest is one which is designed to dry 2½ million pounds of rubber per annum. In addition to being by far the largest warm air drying house in Ceylon this installation differs in certain details from the standard R.R.S. design. After rather lengthy trials, in the course of which the Research Scheme was called on for advice, the drying house was finally adjusted to dry crepe of normal thickness in 3 days with remarkable efficiency.

The main advance in smokehouse practice during the year has been the introduction of the R.R.I. Tunnel Type Smokehouse to Ceylon. The first smokehouse of this type was erected at an estate near Dartonfield under the Chemist's general direction. The Research Scheme is indebted to the proprietors and manager of this estate for the facilities so freely provided. Local planters have shown much interest in this smokehouse and many requests have been received for plans and specifications. It is expected that several more tunnel smokehouses will be erected in Ceylon in the coming year.

ADVISORY WORK.

During 1940 there was a marked increase in the number of demands on the Chemical Department for advisory services. Interest in modern methods of manufacture was more active than in previous years, doubtless owing to the sustained high selling price of Rubber. At one stage an unprecedented premium on smoked sheet in the Colombo market led

a number of estates to consider changing over from crepe to smoked sheet manufacture. Many requests for advice were received also in connection with war-time shortage of coagulants, aluminium and packing materials.

The Chemist made 20 advisory visits to estates during the year.

METEOROLOGICAL OBSERVATIONS.

The summary of weather records for 1940 is as follows :—

	1940	1939
Rainfall (ins.)	151.39	175.21
Highest monthly rainfall (ins)	28.95 (October)	27.89 (August)
Highest daily rainfall (ins.)	7.14 (May 15th)	21.03 (August 9th)
Highest shade temperature (day)	92.9° (Feb. 11th)	94.7° (March 1st
Lowest temperature (night)	64.8° (Jan. 1st)	60.4° (Dec. 7th)
Number of rainy days	241	226.

ENQUIRIES AND CORRESPONDENCE.

Enquiries were dealt with on the following subjects :—

Latex	36
Preserved Latex	10
Factory Procedure and Equipment	64
Drying House Design ...	35
Defects in Raw Rubber ...	19
Alternative Forms of Raw Rubber	14
Uses for Rubber ...	9
Vulcanised Products ...	21
Latex Coagulants ...	70
Miscellaneous ...	21
	299

The volume of correspondence which passed through the Chemical Department was :—

Inward letters (not separately recorded).

Outward letters ... 1,347.

PUBLICATIONS.

War-time Coagulants — A Note on Proprietary Substitutes — First Quarterly Circular, 1940—M. W. Philpott.

Packing Raw Rubber — Fourth Quarterly Circular, 1940—M. W. Philpott.

(Sgd.) M. W. PHILPOTT,
Chemist.

Research Laboratories,
Dartonfield,
Agalawatta
24th January, 1941.

REPORT OF THF BOTANIST & MYCOLOGIST FOR 1940

STAFF

No changes were made in the Staff during the year, and the allocation of duties remained substantially the same as those reported in 1939 (see Annual Report for 1939, p. 48).

Mr. R. K. S. Murray, Botanist & Mycologist, acted as Director during Mr. O'Brien's absence from Ceylon from 8th February to 2nd December.

Dr. C. E. Ford, Geneticist, was absent periodically on military duty for the equivalent of 40 working days.

PATHOLOGICAL WORK

Oidium Leaf Disease

General.—The incidence of Oidium during the refoliation season of 1940 was exceptionally light in most districts except at the highest elevations. This was due to the almost continuous hot, dry weather in the early months of the year, which was inimical to the activities of the fungus but favourable to rapid maturation of the young leaf. A distinction may be drawn with the previous year, 1939, in which the rainfall at the corresponding period was also deficient but the minimum temperatures were exceptionally low. This difference in temperatures is considered to offer an adequate explanation of the fact that the fungus was far more active and caused greater defoliation in 1939 than in 1940.

The continued dry weather was, of course, ideal for sulphur dusting operations, the success of which may be regarded as having contributed materially to the excellent foliage obtained on mid-country estates.

Experimental.—Experimental work on the control of this disease was confined to the search for resistance to infection. Trees which had been marked on two estates in Matale as possibly resistant to Oidium were inspected, but although the foliage had been relatively healthy in 1939 it appeared to be no less susceptible than that of neighbouring trees in 1940. Reports from other estate superintendents were equally disappointing but the matter is being further pursued.

Negotiations were undertaken for the lease of a small block of land at an elevation of about 1,500 feet on which a large "museum" collection of clones could be established to study relative susceptibility to the disease. The acquisition of suitable land from Government having proved

impossible, arrangements were made to lease 25 acres of land planted with Rubber on Kepitigalla Estate Matale, and it is hoped that the planting programme will be commenced in 1941.

Root Disease

Root disease, mainly caused by *Fomes lignosus*, continues to give trouble and to necessitate expensive control measures in replanted clearings. The actual loss of plants, however, is rarely serious (seldom greatly exceeding 1 per cent of the total stand), and there is abundant evidence that provided the correct treatment is undertaken as soon as each fresh focus of infection is discovered (involving complete removal of the source) the incidence shows a marked decrease in the third or fourth year after planting. The problem, therefore, is how to reduce the expenditure on control measures to a minimum rather than how to find a means of preventing excessive loss of plants.

Several estates have carried out periodical rounds of inspection of the root system of individual plants with a view to disclosing and eliminating sources of infection at the earliest possible stage. This work has been done efficiently and cheaply, but in the only experimental comparison available there is, so far, no evidence that the treatment has paid for itself by reducing the number of later losses.

Disease of Budgrafts Near Union

A number of cases of a diseased condition just above the union of budded plants about 18 months old (from budding) have been observed in the replanted clearings on Dartonfield and elsewhere. In an advanced stage the bark is quite dead completely round the stem for a distance of two or three inches immediately above the union, but shows no external lesion. The wood underneath is not discoloured internally and the roots are quite healthy. Such "ringed" plants show symptoms of distress in the foliage and are thus detected.

A tree-to-tree inspection on Dartonfield brought to light a few cases in an earlier stage, and in every case the damage had started on the side opposite to the snag on the "under-hung" portion of the scion immediately above the union. No parasitic fungus was evident nor did it appear that there had been any injury by an animal such as a rat.

The first case was recorded in December, 1939, towards the end of a prolonged spell of wet weather, and it was then thought to be due to unduly moist conditions, the union being shaded with a cane protection basket. Although the remaining plants were all detected in the very dry weather experienced in January/February, this is still held to be a possible explanation as the damage may have started in the wet weather and not become evident until some months later.

In advanced cases a fungus *Nectria* sp. was sometimes found to be growing in the dead cortex, but as this genus mainly comprises saprophytes or mild parasites it is unlikely to be the primary cause of the trouble.

Sun-scorch of Budgrafts

A feature of specimens received for examination was the large number of young buddings which had suffered from sun-scorch of the union during the hot, dry weather in the early months of the year. In many instances the damage was extensive owing to the invasion of Diplodia, and some estates are known to have lost hundreds of plants. The fact that our account of this disease has been published (Quarterly Circular Vol. 10, Part 2, 1933), and that advice has consistently been given that unhealed unions should be shaded on the south and west sides during dry weather, appears to have escaped the attention of many superintendents.

Instances of sun-scorch of the green stem of young buddings were also observed during the exceptional drought. The erection of a cadjan shade on the south-west side was usually sufficient to ensure recovery.

Dieback of Pueraria

At the conclusion of the section of the Annual Report for 1939 dealing with this subject the following was stated :—

> "As mentioned above there is evidence of recovery in some of the affected areas, and it is possible that Pueraria may grow again satisfactorily after the soil has been 'rested' for some months. Some superintendents are endeavouring to re-establish Pueraria with the assistance of manure, and the results of all these trials will be carefully watched."

Enquiries have been made from the superintendents of estates visited by the writer in 1939, and although there are certain conflicting experiences the present position appears to be substantially as follows :—

(1) Once a cover of Pueraria has deteriorated badly it does not, in general, show any recovery even after the application of phosphatic manures. Two exceptions to this general observation have been recorded, but in one case it appeared that the dieback was largely caused by eel-worm infestation, and in the other drought was the main factor. It is possible that nitrogenous manuring might be helpful where the dieback is associated with degeneration of the nodules, for in this condition the plants are, in effect, subsisting as non-legumes.

(2) Attempts to re-establish Pueraria have been unsuccessful, but other covers mainly *Desmodium ovalifolium*, are coming away well. On one estate Vigna, which had been suppressed by the Pueraria for many years, is re-establishing itself.

(3) In general, areas of healthy cover which have been manured with general mixtures during the past 9 months have not shown any deterioration.

Diseases and Pests of Cover Plants

A severe attack of a boring caterpillar, *Indarbela quadrinotata*, on Albizzias was reported from one estate. Albizzias in both Rubber and Tea fields were affected, the most severe attack occurring in a replanted Rubber clearing where the trees had been "ringed" for removal The borer had also gained entrance to a number of three-year-old buddings of TJ.1 in this field, but were apparently only able to do so where an unprotected wood surface was exposed after the removal of a branch. The insects had sometimes eaten the outside "scaly" bark at a fork, but were unable to penetrate healthy tissue.

There was no indication of the Rubber trees having suffered as the result of attack, the "gallery" being mainly confined to the pith in the middle of the stem. It would be wise, however, to take special care to tar any wood exposed as the result of branch breakage in fields in which Albizzias are interplanted.

The superintendent was advised to plug the mouth of the holes with a plastic compound to prevent the emergence of the caterpillars. This appeared to kill the insects enclosed within.

Other diseases and pests on cover crops and Hevea recorded for the first time at these laboratories are included in the following list:—

Name	*Description*	*Host*
Corticium salmonicolor	"Pink Disease" of stem	*Desmodium ovalifolium*
Gymnogryllus numeralis	Lawn cricket	*Albizzia falcata*
Heterodera marioni	Eelworm	*Desmodium ovalifolium*
Indarbela quadrinotata	Boring caterpillar	*Albizzia falcata*
Indarbela quadrinotata	ditto	*Hevea*
Xylaria apiculata	Root disease	*Hevea*
Xyleborus fornicatus	"Shot-hole" borer	*Desmodium ovalifolium*

BOTANICAL WORK

The Improvement of Planting Material

Arising from the Director's visit to Malaya and the N.E.I. early in the year, the Board has decided, in principle, to enlarge the scope of its selection and breeding work. This, however, necessitates the acquisition of further land and it was not possible to implement the decision during the year under review.

A. Budgrafting.

1. Budding, Planting, and Attention.

An experiment was carried out to determine the effect of immersing the tap root of budded stumps in a solution of Hortomone A* 1 : 320 immediately before transplanting. At the same time a comparison was made between cutting the lateral roots at 3, 6 and 12 inches respectively from the tap root. Sample stumps were carefully uprooted at intervals of 1, 2 and 3 months after planting and the new roots counted and weighed. Periodic measurements of the growth of the plants were made and the conclusions are summarised as follows :—

1. The root examination showed that the treatment with Hortomone had stimulated the production of new roots from the cut end of the tap root, and there was also an indication of a larger number of lateral root initials than on the untreated plants.

2. This earlier rooting might be expected to be of practical value in reducing the number of deaths after transplanting, and there was some evidence from the experiment that this was so. The conditions, however, were rather artificial as a severe drought succeeded the planting and the stumps had to be specially shaded and watered.

3. At no stage was there was any indication that the growth of the scion derived any benefit from the stimulus to rooting; in fact the Hortomone treatment appeared to have had a slight depressing effect on the growth of the shoot.

4. No differences were observed between the effects of cutting the lateral roots at 3, 6 and 9 inches from the tap root. An earlier experiment had shown that their entire removal (in the absence of Hortomone) resulted in a greater number of casualties and slower growth.

Taken in conjunction with the results of estate trials, this experiment shows that, under the favourable conditions for transplanting which obtain in most districts in the monsoon planting seasons, there is little

* A proprietary "growth promoting substance."

advantage to be gained by the use of Hortomone A, or probably of other similar substances.

2. Stock-Scion Relationship.

1. As was mentioned in the Report for 1939, illegitimate seedling families of a number of clones were established in a nursery in order to provide material for the study of the influence of stock on scion. Budding will be carried out early in 1941, but in the meantime observations were made on a representative number of plants in each family as regards: root system (distribution and weight of roots), height and girth of the stem, and yield on pricking with the Testatex* knife. The latter consists of a flexible strip of metal with four V-shaped knives fixed approximately an inch apart. The knife is pressed into the cortex of the young seedling with the bottom of the lowest V about 2 inches from the ground. It is then withdrawn and when the flow of latex has ceased the plant is classified according to the following grades:—

I. The latex flow from the four cuts joins up and trickles to the ground.

II. Ditto, but the latex does not flow as far as the ground.

III. The beads of latex do not flow far enough to join up with one another.

IV. Beads of latex appear on the cuts without any flow.

V. The latex exudation is insufficient to form beads.

There is evidence that when this test is applied to young seedlings about 12 months old some indication of future yield potentialities is given. The seedlings in question were 13½ months old.

The data obtained are summarised in Table I. It is interesting to note that substantial differences occur between the various families as regards the classification on the Testatex test although the growth is comparatively uniform. Those parents known to give valuable seedling progeny, viz. TJ. 1, AV. 163 and BR. 2, give the best reaction to pricking.

2. Tapping was commenced in March in a block on Mukalana Estate in which buddings of Tj. 16 and B.D. 5 were made in 1931 at a height of 3 feet. Each tree is tapped on the Double-Four system (2S 2, d/4, 100 per cent), one cut being opened on the scion at a height of 20 inches from the union and the other on the stock at 24 inches from the ground. Individual yields are being kept from each cut. It has not been possible to complete the statistical computations relating to 1940 for inclusion in this report.

* By kind permission of Dr. P. J. S. Cramer, the patentee.

3. Studies on Clones.

(1) *Clone Trials.*—A new clone trial area was planted with budded stumps at Nivitigalakele. 36 clones are included, being mostly the newer clones developed in Malaya and the N.E.I. A quasi-factorial lattice design has been adopted with two replications of each of three arrangements, giving six replications in all. Plots consist of 4 trees.

Test plots of the most promising Ceylon clones have been established on estates in the Kalutara, Ratnapura and Matale Districts to study their reaction to different environmental conditions. Arrangements have been made for similar plots to be budded in the Kurunegala District in 1941.

(2) Yield Records.

(a) Ceylon Clones.—Test-tapping of Ceylon clones has been continued at Nivitigalakele, Wagolla, and on various estates co-operating with the Scheme, and the usual annual summary of yield records was published in the First Quarterly Circular. Two clones — MK. 3/2 and WG. 6278 — are now included in the list of those recommended for commercial use on a large scale, provided the conditions of soil and rainfall are similar to those at Nivitigalakele. HC. 28 is approved for planting on a relatively small scale. The yields for 1940 of the original test-tapped trees of these three clones are as follows:—

Clone		No. of Tappings	lbs. per tree
MK. 3/2	...	123	16.7
WG. 6278	...	118	15.0
HC. 28	...	120	11.7

(b) Imported Clones.—In addition to the test-tapping records from small groups of trees, an increasing number of figures from the commercial tapping of areas of imported clones is now becoming available. Consideration will be given in 1941 to the circulation of a questionnaire with a view to collating all possible data. In the meantime it may be said that most of the records received to date are satisfactory when the previous history of the area in question is taken into consideration.

(3) Identification of Ceylon Clones.

Dr. Ford devoted a considerable amount of time to the systematic study of the vegetative characteristics of the most important clones developed from Ceylon mother-trees, and a publication describing and illustrating six clones was with the printers at the end of the year. It is hoped that the manual will be useful in enabling estate superintendents to check the identity of their grafts before multiplying the clones on a large scale.

4. Exchange of Clones.

Budwood of Clones MK. 3/2, WG. 6278 and HC. 55 was sent to the Proefstation West Java, and of the two former clones to the A.V.R.O.S Proefstation, Sumatra, in exchange for which the following clones were received :—

P.R. 105, 106, 107 and B.D. 17 from Java.

A.V.R.O.S. 255 and 352 from Sumatra.

The condition of the material sent to Java and Sumatra testified to the efficiency of our packing methods. Owing to delays in shipping the three consignments were 21, 26 and 31 days respectively in transit. Despite these long periods the budwood was reported on as arriving in fair condition, and an over-all average of 11 successes per yard of budwood was obtained. The maturity of the budwood is held to be mainly responsible for its good keeping qualities.

B. Breeding Investigations

(1) Artificial Pollinations.

5,797 artificial pollinations were made during the course of the 1940 flowering season as compared with 2,565 in 1939. Crosses were made between buddings of five high yielding Ceylon clones as seed parents and the same five clones, together with TJ. 1 and B.R. 2, as pollen parents. In addition, a number of self-pollinations were made.

The year was an unfortunate one in several respects: MK. 3/2 and HC. 28 again failed as seed parents, though trees were chosen at the margin of the field well exposed to light and air; MK. 1/3 pollen proved to be sterile, or near sterile, and gave no success at all, even with clone BS. 3 which is a very fecund female parent; though setting of fruit was satisfactory there was a heavy fall between setting and ripening; finally, the only one tree of WG. 6278 used, and which was carrying a good crop of fruit, was blown down in a storm during May.

104 fruits were harvested, and as germination was very good, 304 seedlings were raised and later planted out in a nursery. In view of the misfortunes mentioned above, the over-all percentage of success of 1.7 is not a very useful figure as an indication of the adequacy of the technique. The full results are given in Table II.

Experience in other countries has shown that though most clones are self sterile, or nearly so, some are capable of setting abundant self-pollinated seed. Since such seed often give rise to weakly seedlings, it is obviously a matter of importance to know whether a clone is, or

not, self-sterile when the composition of seed gardens is being considered. It was for this reason that self pollinations were included in the breeding programme for 1940. Each new clone which is used for breeding work and which may be planted in a seed garden will be tested in this way

2. Seed Gardens.

Arrangements have been made for six seed gardens to be established on estates in 1941 with the clones used in the artificial pollination programmes. Five of these will be isolated in jungle, and the sixth will be in a replanted clearing surrounded by Clone P.B. 86.

(3) Illegitimate Clonal Families.

Seeds of 16 clones at Nivitigalakele were collected and planted either in the nursery or in the field for later study. It is thought that pricking tests of these illegitimate seedlings may afford some guidance as to which of the clones, all of which are derived from high yielding estate mother trees, are likely to prove of value as parents for artificial pollination.

Seeds of four of these families were twinned in order to provide a comparison of growth with untwinned individuals.

C. **Cytogenetics**

D. **Bark Anatomy**

Periodical absence on military duty prevented Dr. Ford from devoting any attention to these subjects which are on the general research programme.

Problems Connected with Mature Areas

A. **Tapping**

1. Mature Seedling Trees.

(a) Experiment on Dartonfield.—The experiment on Dartonfield, in which eleven different systems of tapping are under comparison, completed its third year in February, 1940. The results for the first three years were published in the Third Quarterly Circular for 1940 and are summarised in Table III.

Yield.—Every treatment showed an increase in 1939/40 relative to No. 1, this being due to a marked decline in the yield of the latter plots for which no obvious explanation can be found.

The yields of the less intense systems, No. 2, 6, 7, 9, 10 and 11, have shown progressive annual increases, thus indicating a benefit to the trees from the periodic rest or increased interval between tappings.

System No. 8, 2S 2, d/3, 133%, maintains its superiority, and although the additional crop has never attained the theoretical figure of 33% there is no evidence of a retrogression in either yield or dry rubber content of the latex. These results have enabled us to suggest the adoption of this system as a temporary expedient on estates which anticipate difficulty in harvesting their standard assessment in 1941 owing to a large proportion of the acreage being replanted and therefore out of commission.

Bark Renewal.—No significant differences in bark renewal after 3 years are shown, and it is evident that under the conditions of the experiment the rate of bark renewal is not a factor of any importance in assessing the relative merits of the various systems under trial. It might, however, be unwise to apply this conclusion to trees on which, for any reason, the rate of renewal is much slower.

Brown Bast.—There is a clear indication that the less intense systems of tapping have resulted in a smaller proportion of trees affected with this disease.

(b) Slaughter Tapping.—Drastic tapping was undertaken during 1940 in an area of about 3½ acres on Dartonfield which is to be replanted in 1941. The area was insufficient to lay out a satisfactory experiment but the results are of interest.

During December, 1939, and January, 1940, the trees were tapped on 2S/2, d/3, 133%. No tapping was done in February, and the cuts were re-opened in March on 2S/2, d/2, 200%. This was continued until the end of the year, an extra cut being opened on each side of each tree on 20th November. The treatment for the last six weeks thus became 4S/2, d/2, 400%.

The yield for the complete year 1940 was 860 lbs. per acre, which probably represents an increase of about 60%.

The dry rubber content of the latex dropped from 38% in December, 1939, to 24% in December, 1940.

Of 319 trees in tapping at the commencement, 16 went dry on both panels and 6 on one panel.

2. Young Budded Trees.

(a) Experiments on Estates.—In the Report for 1939 mention was made of four tapping experiments commenced during that year in budded areas on estates, and yields were tabulated for the first tapping year or portion thereof. In three of the four experiments the tapping year does not correspond to the calendar year, but in order that the information given in this report may be as up to date as possible the yields for

the calendar year 1940 are shown in Table IV. The points of main interest are summarised as follows :—

Yield.—With TJ. 1 the adoption of either of the tapping systems with a relative intensity of 67% involves a loss in crop of only 15%—20%. In both experiments 1 and 4, S 3, d 2 has given a slightly higher yield than S 2, d 3, though the latter would give the cheaper tapping. With A.V.R.O.S, 49 and B.D. 5, however, it would appear that the trees do not respond so well to the reduced intensity, and the yield on third-daily tapping (S 2, d/3) is no higher than the theoretical figure of 67%. This conclusion, however, must be accepted with reserve as Experiment 4 is not replicated within each clone.

A feature of the second year's tapping is the increase in the relative yield of Systems 4 and 5 (2S/2, d/4 and S/1, d/4) with all clones. The increase would have been greater in the case of TJ. 16 had not an exceptionally severe storm in May destroyed a large number of trees, the damage being, by chance, heavier in these plots than in those of System No. 1. The extra crop obtained by these methods of tapping, however, is largely in the form of cup lump due to late dripping. With TJ. 1, for example, the proportion of scrap and lump on the Double-Four System (2S/2, d/4) is 26.4% as compared with 16.% for S/2, d/2.

Too much weight should not be attached to a comparison of the yields between the several clones as the conditions are not always comparable. In Experiment 1, for instance, two of the replications are situated at an elevation of 1,000 ft. where the conditions are not favourable for high yield. The increase in yield of B.D. 5 during the second tapping year has been very satisfactory in both Experiments 1 and 4.

Dry Rubber Content.—The dry rubber content of latex continues to be very low in all areas. The mean values for the three clones in Experiments 1—3 on S/2, d/2 are as follows :—

TJ. 1	...	...	26.2 per cent.
B.D. 5	...	...	24.5 „ „
TJ. 16	...	...	26.2 „ „

The corresponding figures for Systems 2 and 3 are slightly higher and those for 4 and 5 slightly lower.

Bark Renewal.—Measurements of the thickness of 12 months old renewal showed that in the case of B.D. 5 and TJ. 16 the renewal was substantially greater on Systems 4 and 5 than on System 1, the difference being of the order of 12%. In the TJ. 1 areas, however, no differences were evident between any of the treatments. The rate of renewal is satisfactory in all cases.

Brown Bast.—The incidence of Brown Bast has not so far been serious in any series of plots. The highest percentage is 3.5% in the Double-Four plots of TJ. 1 in Experiment 1.

(b) Small-Scale Experiments at Nivitigalakele.—Two experiments were commenced at Nivitigalakele during the year with the small number of trees of Clones MK. 3/2 and HC. 28 available. In the former clone 18 trees are tapped on each of the following systems :—

(1) S/2, d/2, 100%.
(2) S/3, d/2, 67%.
(3) 2S/2, d/4, 100%.

while with HC.28 10 trees are tapped on each of systems (1) and ((2). The trees were individually test-tapped on S/2, d/2 for a preliminary period of three months, and the treatments then allocated in single tree plots in accordance with these records. The results for the 7 months' period June-December, 1940, are given in Table V. The trees were mostly budded in 1930 with a few 1931 and 1932 supplies.

TABLE V

Yield in grams per tree per tapping June-December, 1940.

(Figures in brackets denote per cent. of S/2, d/2, 100%).

	1	2	3
Tapping System	S/2, d/2, 100%	S/3, d/2, 67%	2S/2, d/ 4, 100%
MK. 3/2	41.6 (100)	31.9 (77)	79.7 (191)
HC. 28	35.0 (100)	26.6 (76)	

The theoretical percentage for System (3) is 200, and the shortfall on this figure is accounted for by the fact that trees developed Brown Bast and had to be taken out of tapping after a few months on this system. Two further trees of MK. 3/2 developed the early symptoms of this disease, one in System (1) and the other in System (3), but tapping was continued with the affected portions isolated by cuts to the wood.

B. **Cover Crops.**

General.—The position regarding the deterioration of covers of *Pueraria phaseoloides* under mature Rubber is summarised earlier in this report. A general replacement of this species by *Desmodium ovalifolium* is taking place in affected areas. This cover is easily established though its rate of spread is slow, and it remains to be seen for how many years it will persist under the unfavourable combination of factors—heavy shade and poor soil,

Natural Covers.—In the Annual Report for 1939 a detailed account was given of the plant associations in the 20-acre block on Dartonfield allocated to the growth of natural covers. No material changes have occurred in 1940.

The yields of this block are compared below with those of the whole estate :—

	Whole Estate	"Forestry" Block.
1936 (natural covers commenced)	575 lb. per acre	653 lb. per acre.
1937	600 „ „ „	609 „ „ „
1938	593 „ „ „	580 „ „ „
1939	542 „ „ „	575 „ „ „
1940	546 „ „ „	608 „ „ „

The general trend of these figures suggests that whereas there was a set-back in yield in the early stages of regeneration due to excessive competition between the natural covers and the Rubber trees, a state of equilibrium has now been reached and the improved type of vegetation may, in fact, be exercising a directly beneficial effect. The "forestry" block was planted in 1910 and comprises the oldest trees on the estate.

The planting of a 10-acre block of jungle land at Nivitigalakele without a burn will afford the opportunity for a study of the regeneration of natural covers *'ab initio.'* Further land will be cleared by the same methods in 1941.

C. **Replanting.**

The results for the replanting experiments on Dartonfield, other than those dealing with manurial problems which are recorded in the Soil Chemist's Report, are summarised below.

Experiment No. 1, 1934 Clearing (7½ Acres).—This area was replanted with budded stumps in June, 1934, the purpose being to compare : (1) methods of disposal of the old timber, (2) species of ground cover crops, and (3) methods of controlling the ground cover. Three blocks are planted respectively with Clones Glenshiel 1, A.V.R.O.S. 256 and Prang Besar 25. The mean girth measurements for the various experimental treatments in 1936, 1937, 1938, 1939 and 1940, and the increments during the year 1939-40, are given in Table VI.

None of the treatment effects is now significant. Reviewing the general trend of the figures over the full period of the experiment, it would appear that up to the third year the thicker and more vigorous covers, Pueraria and Centrosema, exercised a greater retarding effect on the growth of the young Rubber trees than the lighter covers, Calopogonium and Vigna, but thereafter the opposite tendency is to be noted. The latter species have become very thin under the increasing shade, and in order to prevent erosion it has been decided to discontinue the experimental comparisons and plant these plots with Pueraria and Centrosema respectively.

It has not been possible to arrive at any conclusions regarding the treatments of the old timber, except for the significant fact that none of the five outbreaks of root disease occurred in the plots from which the larger laterals were removed. There is slight evidence, however, that this procedure may have resulted in slower growth.

The field was almost fully tappable at the end of 1940 and will be taken into tapping after the wintering period of 1941.

Experiment No. 3, 1936 Clearing (9½ Acres).—The following series of comparisons are being made in this area, and the figures for 1939 and 1940 and the increments for 1939/40 are given in Table VII.

Methods of Opening—

1. Planting on contour platforms.
2. Planting in contour trenches.
3. Contour planting, with level pitted drains between the contours.

Methods of Planting—

A. Planting budded stumps (Planted May, 1936).

B. Planting stumped buddings (Planted May, 1936)

C. Planting one basket plant and four germinated seed in each hole for subsequent budding in the field. (Planted September, 1936, and mostly budded November-December, 1937).

Manuring—

X. A complete inorganic mixture.

Y. A complete organic mixture.

Measurements of girth were made in June and the figures for 1939 and 1940 and the increments for 1939/40 are given in Table VII.

TABLE VII.

Mean Girth per Plant in Inches.

1.	1939	1940	Increment 1939-1940
Methods of Opening—			
1. Platforms	8.99	12.46	3.47
2. Trenches	8.87	12.17	3.30
3. Pitted Drains	8.07	11.39	3.32
Standard Error	.198	Not	
Significant Difference (.05)	.69	significant	
Methods of Planting—			
1. Budded Stumps	9.19	12.77	3.58
2. Stumped Buddings	11.84	15.33	3.49
3. Field Buddings	4.89	7.91	3.02
Standard Error	.266	.273	.165
Significant Difference (.05)	.79	.81	.49

Methods of Opening.—There are no significant differences between the treatments on the basis of the 1940 figures though the evidence of poorer growth in the pitted drain plots persists. There is unfortunately one replication which contains a block of very poor soil and it happens that the platforms are not represented in this poor area. If this replication is omitted from the calculations the level of growth in the trenches and pitted drains is raised in comparison with the platforms. It is probable that a truer assessment of the growth under these three systems of opening is thereby arrived at.

Methods of Planting.—The stumped buddings retain their advantage over the budded stumps, and both are significantly larger than the plants budded in the field. The latter do not show any greater rate of girth increase than the budded stumps at the corresponding stage of development.

D. **Bark Renewal.**

An experiment was initiated to determine whether periodical applications of certain vegetable oils to tapping panels were of any value in stimulating the regeneration of the recently tapped cortex. After six months no effect was evident, but trials are being continued and a fuller report will be made at a later date.

ADVISORY WORK.

Visits to Estates.

The undermentioned visits were paid to estates (excluding visits to Nivitigalakele). Requests for consultative visits had sometimes to be refused, or the date deferred, on account of Mr. Murray's addtional duties as Acting Director.

Officer		Advisory	Experimental
R. K. S. Murray	...	26	27
C. E. Ford	...	—	8

Specimens and Enquiries.

An encouraging feature of the advisory work of the Botanical Division is the increased number of enquiries for advice on general planting problems which are being received from Ceylonese proprietors and superintendents.

As in previous years the choice of planting material is the subject on which the largest number of enquiries is received. An increased interest in the possibilities of using 'clonal' seed has been shown. The increased number of enquiries on methods of tapping is a reflection partly of the enhanced exportable quota and partly of the fact of young budded clearings becoming tappable. The small figure for the number of enquiries on root disease is rather misleading as most of such enquiries are received in connection with disease specimens which are not included in this list.

Enquiries were dealt with on the following subjects (figures for 1939 in brackets) :—

Botanical—

Planting material	...	140	(112)
Budding procedure and after treatment		37	(44)
Replanting procedure	...	31	(40)
New planting	...	18	(21)
Seed gardens	...	17	(3)
Nurseries	...	7	(6)
Manuring	...	24	(25)
Cover crops	...	31	(45)
Tapping	...	51	(17)
Miscellaneous	...	19	(16)
		375	(329)

Pathological—			
Oidium and sulphur dusting	...	18	(43)
Root Disease	...	10	(21)
Control of animal pests	...	22	(52)
Miscellaneous	...	50	
		100	(116)
		475	(445)

Specimens were received for report from 124 estates as compared with 141 in 1939.

During the year the cyclo-styled "Planting Memoranda" were revised and issued in printed form as "Advisory Circulars." The circulars prepared by the Botanical Division, with the number of copies issued in 1940 (excluding general issues from the Head Office), are as follows :—

No. 1.	Notes on budgrafting procedure	...	28
No. 3.	Notes on Rubber seedling nurseries	...	24
No. 4.	Contour lining, holing and filling, cutting of platforms, trenches and drains	...	23
No. 6.	Notes on the care of budded trees of Clone Tjirandji 1 with special reference to wind damage		34
No. 8.	Planting and after-care of budded stumps	...	99
No. 10.	Root disease in replanted areas	...	24
No. 14.	Rat Control	...	—

Visitors.

Personal interviews with visitors constitute a useful feature of advisory service, but the number of visitors to the botanical laboratories, as distinct from visitors to the estate and head office, has not been recorded.

PUBLICATIONS.

1. Ceylon Clones—VIII (1939)—Quarterly Circular, Vol. 17, Part 1. C. E. Ford.

2. Field Experiments on Dartonfield Estate—XI.—Manuring Experiment with Mature Rubber (1939)—Quarterly Circular, Vol. 17, Part 1. L. A. Whelan and C. A. de Silva.

3. *Planting Material—Quarterly Circular, Vol. 17, Part 2. C. E. Ford.

4. *Tapping Young Budded Trees—Quarterly Circular, Vol. 17, Part 2. R. K. S. Murray.

5. Field Experimets on Dartonfield Estate—XII—Comparison of Tapping Systems—Quarterly Circular, Vol. 17, Part 3. R. K. S. Murray and C. A. de Silva.

6. The Performance of Imported Clones in Ceylon—IV.—Quarterly Circular, Vol. 17, Part 3. C. E. Ford.

7. Field Experiments on Dartonfield Estate—XIII.—Measurements of Growth in Replanted Areas (1940)—Quarterly Circular 17, Part 4. L. A. Whelan and C. A. de Silva.

8. The Identification of Ceylon Clones of Hevea Brasiliensis. C. E. Ford. (In the Press).

* Lectures given at Rubber Conference sponsored by the Planters' Association of Ceylon.

(Sgd.) R. K. S. MURRAY,
Botanist and Mycologist.

Rubber Research Scheme (Ceylon).
Research Laboratories,
Dartonfield,
Agalawatta.
15th February, 1941.

TABLE I.

Observations on Illegitimate Clonal Seedlings 13½ Months Old.

Family	Mean Girth in Inches		Mean weight of roots per plant grams (7 months old).	Testatex Test Percentage plants in grade.				
	All plants	Test-pricked plants		1	2	3	4	5
TJ. 1 (1)	2.4	2.7	2.7	50	15	27	8	0
TJ. 1 (2)	2.3	2.7	—	12	23	40	25	0
AV. 163	2.4	2.9	2.5	27	10	28	35	0
B. R, 2	2.4	2.9	2.1	15	12	33	40	0
W. 259	2.4	2.9	3.8	15	12	28	45	0
M. 113	2.4	2.9	1.5	12	5	30	50	3
B. S. 3.	2.7	3.0	1.7	12	10	18	42	18
MK. 1/3	2.4	2.9	2.7	10	20	32	38	0
TJ. 16	2.3	2.9	1.0	7	18	55	20	0
B. D. 10	2.4	2.9	1.5	7	15	50	28	
W. 320	2.6	2.9	4.0	7	5	33	52	3
HC. 28.	2.5	3.0	2.7	2	18	18	62	0
MK. 3/2	2.4	3.0	2.2	0	17	35	45	3
MK. 1/1	2.7	2.9	1.5	0	7	20	73	0
HC. 54	2.6	3.0	2.6	0	0	18	77	5
Unselected	2.5	3.0	1.1	7	15	20	48	10

Summary of Crosses made in 1940.

Family	No. of Pollinations	No. of Fruits set	No. of Fruits harvested	Percentage of success.	No. of Seeds planted	No. of Seeds germinated.	Percentage of germination.
WG.6278 × MK. 1/3	202	0					
× TJ. 1	463	26					
× MK. 3/2	26	2	Mother tree broken by wind and all fruits lost				
× HC. 28	32	3					
× WG. 6278	452	2					
MK.1/3 × WG. 6278	393	12	4	1.0	12	12	100
× BS. 3	193	2	2	1.0	6	6	100
× TJ. 1	256	1	0	—	—	—	—
× MK. 3/2	249	4	4	1.6	12	12	100
× HC. 28	138	14	0	—	—	—	—
B.S.3 × MK. 1/3	154	0	0	—	—	—	—
× TJ. 1	204	40	39	19.1	118	111	95
× HC. 28	198	60	53	26.8	159	157	99
× BS. 3	221	1	0	—	—	—	—
MK.3/2 × WG. 6278	392	1	0	—	—	—	—
× TJ. 1	365	0	0	—	—	—	—
× MK. 1/3	151	0	0	—	—	—	—
× BR. 2	35	0	0	—	—	—	—
× HC. 28	152	2	0	—	—	—	—
× MK. 3/2	127	0	0	—	—	—	—
HC.28 × WG. 6278	353	7	2	0.6	6	6	100
× TJ. 1	119	0	0	—	—	—	—
× MK. 1/3	248	0	0	—	—	—	—
× MK. 3/2	291	0	0	—	—	—	—
× HC. 28	383	2	0	—	—	—	—
All families ...	5,797	179	104	1.7	313	304	97

TABLE III

Tapping Experiment (Dartonfield) Results 1939/40.

	Tapping System	Percentage Yields (adjusted as regression on uniformity trial) 1937/38	1938/39	1939/40	1937/40	Scrap as per cent of total	Mean D. R. C. %	Bark renewal in mms. (3 years)	Percentage trees with Brown Bast in June, 1940
Sub-Block A Two/Four-Day Series	1. S/2,d/2 (2×6m/12) 100% ...	100.0	100.0	100.0	100.0	11.0	41.2	6.7	2.2
	2. S/2, d/2 (2×6m/12), 12m/18, 67%	70.8	74.0	86.6	76.4	11.2	40.8	7.0	1.7
	3. S/2, d/2 (2×2d/4), 100% ...	110.4	108.6	109.3	109.3	11.0	40.3	7.0	4.4
	4. 2S/4, d/2, (2×6m/12), 100% ...	85.0	94.5	102.8	93.5	10.1	41.6	7.0	3.9
	5. 2S/2, d/4, 100% ...	96.8	105.7	107.4	103.0	10.5	41.9	7.3	6.1
	6. 2S/2, d/4, 12m/18, 67%	73.2	74.2	96.8	77.3	8.8	41.3	7.6	0.5
Sub-Block B Three-Day Series	7. S/2, d/3 (2×6m/12), 67%	67.8	71.2	79.5	72.2	12.0	42.2	7.4	2.2
	8. 2/S, d/3, 133%	112.3	111.6	123.4	115.2	11.2	41.1	7.3	6.7
	9. 2S/2, d/3, 6m/12, 67% ...	69.0	73.6	82.1	74.3	11.5	40.5	7.2	1.7
	10. 2S/2, d/3, 12m/18, 89,%	75.8	77.6	94.7	81.8	11.8	40.5	7.2	2.8
	11. 2S/2, d/3, 8m/12, 89%	81.0	89.0	101.0	89.6	10.8	40.4	7.1	3.9
	Standard error ...	3.4	3.8	5.1	3.8				
	Significant difference (.05) *within* sub-blocks ...	9.5	10.6	14.4	10.6				
	Significant difference *between* sub-blocks	10.5	10.5	17.4	11.0				

Note.—The abbreviations for the several tapping systems are in accordance with the revised version of the International Standard Notation (See Quarterly Circular Vol. 17, Part 3, p. 239).

TABLE IV

Tapping Experiments with Budded Trees. Yield in lb. per acre (total rubber) for 1940 and percentage comparison with S/2, d/2, 100% (Figures in brackets denote number of tappings).

Expt. No.	Clone	Locality	Year budded or planted	Tapping commenced	Acres	1 S/2, d/2, 100% Yield p.a.	1 p.c.	2 S/3, d/2, 67% Yield p.a.	2 p.c.	3 S/2, d/3, 67% Yield p.a.	3 p.c.	4 2S/2, d/4, 100% Yield p.a.	4 p.c.	5 S/1, d/4, 100% Yield p.a.	5 p.c.
	Initial Height of Cut/s (inches)					34		24		26½		39 & 21½		21½	
1.	TJ.1	Kalutara & Ratnapura	1931/32	Apl. 1939	34	646 (139)	100	552 (137)	85	530 (94)	82	708 (69)	110	687 (69)	106
2.	B.D.5	Kalutara	1931/32	Apl. 1939	20½	598 (138)	100					629 (69)	105	653 (69)	109
3.	TJ.16	Ratnapura	1931/32	Aug. 1939	21	673 (147)	100					700 (73)	104	682 (73)	101
4.	TJ.1				5.3	599 (139)	100	505 (141)	84	477 (93)	80				
	AVROS. 49	Elpitiya	1931	Jan. 1939	5.8	588 (143)	100	466 (139)	79	387 (93)	66				
	B.D.5				3.6	673 (142)	100	504 (141)	75	450 (93)	67				

p.a. =per acre.
p.c. =per cent.

Notes (1) The acreages given are equally divided among the systems of tapping under trial.
(2) The initial heights of tapping cuts in Expt. 4 were slightly in excess of those given.

TABLE VI.

Budded Stumps Planted, June, 1934.

Girth in inches at 3 ft. from Union

Treatments	1936 Age 2 years	1937 Age 3 years	1938 Age 4 years	1939 Age 5 years	1940 Age 6 years	Increase 1939-40
Species of Cover :—						
1. *Centrosema pubescens* ...	5.16	8.93	13.40	17.29	20.92	3.63
2. *Pueraria phaseoloides* ...	4.95	8.61	13.56	17.86	21.41	3.55
3. *Calopogonium mucunoides* ...	5.51	9.36	13.83	17.69	21.16	3.47
4. *Dolichos Hosei* (Vigna) ...	5.43	9.66	14.49	18.48	21.90	3.42
Mean	5.26	9.14	13.82	17.83	21.35	3.52
Standard Error ...	—	0.19	0.18	—	—	—
Significant Difference (P=.05) ...	Not Significant	0.64	0.61	Not Significant		
Timber Treatments :—						
A. Leaving all main stems lying unburned	5.38	9.38	14.06	18.08	21.68	3.60
B. Burning all timber on the land	5.19	9.16	13.94	17.99	21.40	3.41
C. As B, but also removing and burning all larger lateral roots ...	5.22	8.88	13.46	17.42	20.97	3.55
Mean ...	5.26	9.14	13.82	17.83	21.35	3.52
Differences ...	Not Significant					
Control of Cover :—						
X. Keeping platforms clean weeded ...	5.30	9.17	13.76	17.64	21.23	3.59
Y. Ring-weeding in 6ft. diameter circle ...	5.22	9.10	13.88	18.01	21.46	3.45
Mean ...	5.26	9.14	13.82	17.83	21.35	3.52
Differences ...	Not Significant					

REPORT OF THE SOIL CHEMIST FOR 1940

STAFF AND ORGANISATION

The Soil Chemist was in charge of the work of the Department during the year. Military duties were responsible for the loss of 17 working days; during these periods and during the absence of the Soil Chemist on local leave, the Analyst, Mr. P. Tharmalingam, was in charge of the laboratory.

Close co-operation has been maintained during the year between the Soils and Botanical Departments, and the Assistant Botanist has continued his supervision of all field manurial experiments laid down on Dartonfield and Nivitigalakele before the Soils Department was constituted.

MANURING.

(1) Mature Rubber.

(a) General Recommendations.—General recommendations for the manuring of mature Rubber are the same as those given in the 1939 report, but as the position with respect to supplies and prices of artificial manures has deteriorated during the year, some temporary modification of manuring programmes has been made necessary.

For the greater part of the year sulphate of ammonia has not been obtainable, and the choice of an artificial nitrogenous manure has been confined to calcium cyanamide and nitrate of soda. Calcium cyanamide has generally been recommended owing to its lower cost per unit of nitrogen, its calcium content and its lesser likelihood of loss if heavy rain should follow application. This manure is, however, unpleasant to handle, and is liable to cause scorching of ground cover if not brushed off the leaves.

Where nitrate of soda was given it was suggested that the dose be split into two equal parts given at different times in order to minimise the danger of loss by leaching.

Potash stocks are now rationed for Rubber more than 7 years old. The maximum amount that will be supplied is 50% of that normally given, or 20 lbs. muriate of potash per acre, whichever is the greater.

(b) Experiment on Dartonfield.—The fifth year of this experiment was completed at the end of 1940 but yield and growth measurements are not available for inclusion in this report. The results for 1939, up to which time 3 annual doses of experimental manure had been given, were reported in a paper in the Quarterly Circular Vol. 17, Part 1, 1940 and a summary is given in Table I.

TABLE I

Mean Yield in Kilograms Dry Rubber per Plot of 20 Trees.

(To convert to pounds per acre, the figures below should be multiplied by 11.)

Treatment	Preliminary year 1936 (Actual yields)	Adjusted yields 1937		Adjusted yields 1938		Adjusted yields 1939.	
N	53.4	49.8	(111)	56.9	(114)	44.5	(112)
NP	52.3	47.5	(106)	52.9	(106)	41.5	(104)
NK	55.5	49.1	(110)	56.5	(113)	44.1	(111)
NPK	56.5	49.6	(111)	59.3	(119)	46.6	(117)
O	47.1	44.8	(100)	50.0	(100)	39.7	(100)
Mean	53.0	48.2		55.1		43.3	
Standard Error		1.2		1.8		Not	
Significant Difference (P=.05)		3.5		5.3		significant	

(The figures in brackets refer to the yields as percentage of the unmanured plots).

Yields.—In order to correct for the initial (1936) differences between plots the yields have been adjusted by means of a regression on the preliminary figures for 1936.

The mean yield for 1939 is the lowest since the start of the experiment. This may largely be ascribed to the decrease in the number of tappings brought about by unfavourable weather conditions.

The results for 1939 just fail to pass the conventional 20 : 1 test for statistical significance, but the trend of the responses to manures is apparently the same as in previous years. The NPK mixture appears to have given the best result and the NP mixture the poorest apart from the unmanured plots.

The average dry rubber content for the different manurial treatments is given in Table II.

TABLE II

Average Dry Rubber Content for 1939-40.

Treatment			Percentage Dry Rubber
N	...	...	40.4
NP	...	...	39.5
NK	...	...	40.8
NPK	...	...	40.6
Control	...	...	39.4
Mean	...	...	40.1

The results are not statistically significant but there is an indication that when phosphate alone is added to a nitrogenous manure the dry rubber content of the latex is lowered, an effect that has been obtained elsewhere.

This may in part account for the apparent difference in yield of dry rubber between the N and NP plots of this experiment, which is indicated in Table I above.

A comparison of the two methods of applying the manure, broadcasting and forking, gave no indication of any difference in yield.

Growth Figures.—The small differences in girth between the differently manured trees are not significant. Since the taking of the first girth measurements in March, 1937, the trees have shown very little girth increment, an average of only 0.3 in. per year.

Bark Renewal.—The thickness of renewed bark in millimetres for the 3-year period 1937-40 is :—

N	NP	NK	NPK	O	Mean
6.0	6.1	6.0	6.3	6.1	6,1

The results are statistically non-significant and the general response to manuring as shown by increase in bark thickness can only be regarded as doubtful.

In accordance with the change from an annual to a biennial manuring, no manure was applied in 1940.

(2) **Young Buddings.**

(a) General Recommendations.—These are in general similar to those mentioned in last year's report, but changes in the composition of mixtures have been made necessary by the shortage of certain manures brought about by the war. This aspect is covered by an article in the Quarterly Circular, Vol. 17, Part 4.

(b) Experiments on Dartonfield.—Experiment No. 2 (19½ acres). This area which was replanted with budded stumps in 1938 was manured in March, 1940, and again in September. Measurements of girth were made in June, 1940, and reported in a paper published in the Quarterly Circular Vol. 17, 1940, Part IV. A summary is given in Table III.

TABLE III

Mean Girth in Inches per Plant.

Treatment	Mean of 5 Blocks			Mean of 6 blocks June, 1940.
	September 1939*	June 1940	Increment for 9 months**	
O	2.90	4.66	1.76	4.45
N	2.97	4.42	1.45	4.14
P	3.06	4.66	1.60	4.41
K	2.95	4.70	1.75	4.47
NP	2.80	4.70	1.90	4.47
NK	3.18	4.83	1.65	4.55
PK	3.14	5.04	1.90	4.64
NPK	3.34	5.21	1.87	4 80
Compost	3.37	5.13	1.76	4.68

* The September, 1939 measurements given in the Quarterly Circular, Vol. 16, Parts 3 and 4, page 105 were slightly too low owing to an error in calculation. The correct values are given in the present paper.

** To obtain the increment values in column 4, only 5 replications were used, as the plants in one block were too small—owing to late planting—for the September girth measurements.

The results to date point to no significant girth differences among the nine manurial treatments although the complete manure appears to have given the best results.

A comparison of the increment figures from all plots receiving phosphate with that from all plots not receiving phosphate shows a significant response to that nutrient of .17 in. or 10%. A smaller but non-significant response is shown for potash.

Increment values obtained over such a short period as 9 months may have little practical importance, but taken in conjunction with the actual 1940 girth figures they support the R.R.S. general recommendation of an NPK mixture (with K as the minor constituent) for young Rubber.

A differential treatment of the green cover is also being carried out. Loppings are envelope forked in one series of sub-plots and spread over the manured area in the other series. Up to June, 1940, there was no difference in results between the two methods of application.

(c) Experiment No. 3 (9½ Acres).—This experiment, begun in 1936, compares three methods of opening, three methods of planting and two types of manure.

Manures were applied in September-October, 1940. Each budded stump and stumped budding received either 82 oz. organic manure or 45 oz. inorganic (N=5.6 oz. P_2O_5 =3.8 oz. K_2O =2.5 oz.). Field buddings received smaller quantities of manure, in accord with our general principle that such plants should receive the same amount of plant foods as that given to budded stumps at a similar stage of growth.

In June, 1940 girth measurements were made of all plants in the area. Reference to the results for methods of opening and planting will be found in the report of the Botanist and only the comparison between the two kinds of manure will be discussed here.

TABLE IV

Mean Girth per Plant in Inches.

	1939	1940	Increment 1939—1940
Organic	8.64	11.89	3.25
Inorganic	8.65	12.12	3.47
Standard Error			.058
Significant Difference (P = .05)	Not significant	Not significant	.17

The results with inorganic appear to be slightly better than those with organic but this difference of .23 in. or 2% increase over the organic is not significant.

The increments for the period show that the inorganic is the greater by .22 in. or 7% increase over the organic. This increase, though small, is statistically significant (P=.05) and falls just short of the more stringent test (P = .01).

In June, 1939 both series had approximately the same girth but in the following 12 months the response to the inorganic mixture has been slightly greater than that to the organic. It may be that whilst the earlier applications of manure were in excess of the actual needs of the small plants, resulting in equal response to both types of manure, the plants are now well enough developed to assimilate the quantities of plant food added and these are more available in the inorganic than in the organic mixture.

The difference in favour of the inorganic mixture is small, but what is of importance is that under the conditions of this experiment the more expensive organic mixture has to date shown no better result than the inorganic. The stumped buddings and budded stumps were planted in May, 1936 and the total cost of manures per tree, up to the last application in September, 1940, was 49 cents for the organic mixture and 32 cents for the inorganic. A similar ratio for the costs of the organic and the inorganic mixtures was found for the field buddings.

(d) Dartonfield Experiment No. 4 Replanted Area (2 Acres).—This experiment was originally put down to compare a soluble readily available manure with one less readily available. A third treatment included minor elements over and above those present in the soluble inorganic mixture.

Budded stumps were planted in May, 1939. Height and girth measurements were made at frequent intervals. The September mean girths per plant at 4 ins. above ground level were :—

			Ins.
No manure	...	...	3.44
Inorganic	...	...	4.04
Inorganic+Minor Elements	...	...	3.59
Organic	...	...	4.26
Standard Error	...	...	.212
Significant Difference (P=.05)		...	.63

A significant response is shown to organic manure and there are also indications of a response to the inorganic mixture but this falls just short of statistical significance.

As the additional minor elements had produced no increase in growth, the treatment was discontinued and its place taken by an additional inorganic manuring at double the standard rate. A further modification was introduced ; the manuring, starting with the September application, to be done twice yearly instead of every other month.

In September, 13½ oz. animal meal were applied on the organic plots, 10½ oz. inorganic mixture on the standard treatment inorganic plots and 21 oz. on the double inorganic plots.

The December girth measurements were :—			Ins.
No manure	...	...	4.46
Inorganic	...	...	5.22
Double Inorganic	...	...	4.51
Organic	...	...	5.48
Standard Error	...	...	.269
Significant Difference (P=.05)		...	.80

The results again show a significant response to the organic mixture. The apparent response to the inorganic falls just short of significance. Doubling the dose on the inorganic plots has not brought the mean girth of this series to the level of the other manured plots, and, in view of the almost significant difference between standard inorganic and what was previously the inorganic plus minor element treatment, it seems possible that the addition of the minor elements has had some inhibiting effect.

The area is divided into seven replications, four on a shallow loamy soil, subject to water-logging after rain, and three on a deep, red, gravelly soil. The general growth on the shallow soil is poor and that on the gravelly soil is good. Comparison of the two types indicates a substantial response to manuring where depth of soil and drainage are satisfactory, but very little response where these conditions are unsatisfactory.

(e) Nivitigalakele Experiment.—In this experiment compost purchased from an Urban District Council is compared with an inorganic manure mixture of the same NPK content. The area was planted with budded stumps in 1935. During 1940 the total quantities of nutrients applied (in two doses, April and September) were 5.3 oz. N, 4.1 oz. P_2O_5 and 2.1 oz. K_2O per tree. The total weight of compost applied after having been passed through a 1 in. sieve was 65 lbs. per tree.

Girth measurements are taken annually in September and a summary of results for the past 3 years is given below.

TABLE V

Mean Girth per Tree in Inches.

		Compost.	*Inorganic.*
1938	...	6.74	6.85
1939	...	9.94	10.03
1940	...	13.73	13.86
Increment			
1938-1940	...	6.99	7.01

There is no difference in girth between trees given compost and those given an equivalent inorganic mixture. In this experiment, Pueraria and Gliricidia loppings were forked into the soil at the time of manuring, so that all plants received some organic matter.

(f) Application of Manures to the Planting Hole — Pinnagoda 1939 Clearing (10 Acres).—The treatments are Control, P. K & PK. Each manurial plot contains 50 plants and there are 5 replications. The amounts of fertiliser added were 2 oz. muriate of potash for each plant receiving potash and 3.5 oz. saphos for each plant receiving phosphate.

The PK treatment was made up from the above. The manure was well mixed with the soil in the planting hole to a depth of about 2 ft. Planting with budded stumps was carried out in June, 1939 just after addition of the manure. Subsequent manuring of the whole area was carried out according to programme.

Girth measurements at 4 in. from ground level were taken at the end of July, 1940 and a summary is given below :—

Control	P	K	PK	Standard Error	Significant Difference (P=.05).
2.04 in.	2.41	2.00	2.27	.082	.25

Thirteen months after planting, a significant increase of approximately 18% on the girth of unmanured plants was found for phosphate. The lack of response to potash may be due to the burning of the timber on the land prior to cutting holes and the application of wood ash to the holes resulting in an ample supply of potash for the young plants.

(g) Deniya Experiment Nivitigalakele.—This 3-acre area of sandy "deniya" is divided into 5 replications. Planting holes were dug 2 ft. by 2 ft. and 2 ft. deep and 11 ft. by 15 ft. apart, giving a density of 240 plants per acre.

Manurial treatments are the same as those given in the left hand column of Table III. Control plots and a compost treatment are also included. Sixteen plants comprise a treatment plot, 16 by 9 or 144 plants a replication and the whole area contains 720 plants.

Each treatment plot is further sub-divided into 2 sub-plots each containing 8 plants, one sub-plot received slaked lime at the rate of ½ lb. per plant and the other no lime.

The 5 blocks were each planted towards the end of September with one of the following 5 families of illegitimate seedlings in baskets, KOB.41, FR.56, STG.45, BS.5 and H.2.

Lime was applied prior to planting and manures shortly afterwards.

The rate of manuring per plant was, Sulphate of ammonia 1.2 oz., Saphos Phosphate .8 oz. and Muriate of Potash .5 oz. Compost was applied at the rate of 2⅛ lb. per plant.

(h) Experiments on Estates.—In 1938 a number of experiments were laid down in different districts. They are mostly of a simple randomised block design with 8 treatments of N, P and K at 2 levels (0 and 1) and with 4 replications. The plots are manured according to the following scheme :—

TABLE VI

Amount of Fertiliser per Plant.

Approximate time since planting	Sulphate of ammonia oz.	Saphos phosphate oz.	Muriate of potash oz.
9 months ...	2.4	1.7	1.0
15 „ ...	4.9	3.4	2.0
21 „ ...	4.9	3.4	2.0
2 years 3 months ...	9.7	6.8	4.0
3 „ 3 „ ...	17.0	11.9	7.0
4 „ 3 „ ...	26.7	18.6	11.0

A number of experiments have been discontinued, in some cases due to the incidence of root disease having upset the balance of the experiment. This year's girth measurements of the experiments still in progress have been summarised and are given in Table VII.

TABLE VII

Mean Girth in Inches per Plant (1940).

Series No.	Time since planting (yrs.)	O	N	P	K	NP	NK	PK	NPK	Significant difference
1	2½	—	5·3	—	—	6·0	—	—	7·0	·66 (P=.05)*
2	2¾	6.2	6,5	6,8	6.3	6.2	6.3	6.2	6.1	Not significant
3	3	7.9	7.8	8.6	8.2	7.9	8.3	7.8	8.1	„
4	3 1/3	9.8	10.3	10.3	10.3	10.4	10.4	9.9	10.6	„
5	3½	7.1	7.3	7.4	7.1	7.4	6.3	6.7	7.3	„
6	3½	8.6	8.9	9.5	9.0	9.0	9.2	9.5	9.3**	
7	4	10.6	10.9	11.1	10.9	11.3	11.3	11.1	11.6	.44 (P=.05)
Mean (Excluding No. 1)	3⅓	8.4	8.6	9.0	8.6	8.7	8.6	8.5	8.8	

* The quantities of manure applied here were somewhat in excess of those detailed in Table VI.

** In this experiment the general response to phosphate averaged over all other treatments is significant (P=.05).

Plants without P		Plants with P.
8.9 in.	...	9.3 in.

The mean values for experiments 2—7 have not been examined statistically, but they give an indication of a small general response to manuring, and a slight superiority of phosphate to other plant foods.

A more comprehensive experiment involving 27 treatments each replicated 4 times was begun in 1938 at Matale on a limestone soil and is still in progress. Three levels were laid down for each nutrient *(i.e.*, no manure, standard dose as in Table VI and double standard dose) and all combinations of treatments were included. The results of girth measurements to date are not significant but a general mean is given below for each level of each nutrient.

Mean Girth in Inches per Plant.

(Budded stumps planted November, 1937).

		February, 1940	February, 1941.
No nitrogen	...	4.5	7.6
Single nitrogen	...	4.5	7.7
Double nitrogen	...	4.4	7.8
No phosphate	...	4.5	7.9
Single phosphate	...	4.4	7.5
Double phosphate	...	4.5	7.7
No potash	...	4.3	7.4
Single potash	...	4.6	7.9
Double potash	...	4.5	7.8

No statistically significant response has yet been obtained to manuring, even at the relatively high rate of the double dose.

A further treatment was included to study the acidifying effect of sulphur on this limestone soil, and the possibility that more acid soil conditions might lead to improved growth. Half a pound of sulphur per plant was applied in 1938 to half the total number of plants and the application was repeated in 1940. Eighteen months after the first application, the soil on one of the four blocks was sampled and a mean pH value of 4.7 was found for the treated soil and 6.0 for the untreated. This represents a considerable increase in acidity, but no growth response by the plants was shown by the 1941 measurements.

Mean of 1080 plants without sulphur		Mean of 1080 plants with sulphur
7.7 ins. girth	...	7.7 ins. girth

(i) General Conclusions.—Experiments on Dartonfield and on estates give little evidence of any response to nitrogen, and at only one centre is there evidence of a satisfactory response to potash. The addition of small amounts of phosphate to the planting hole, and the application of further doses after planting, have resulted in increased girth increment of young trees on some areas.

To date, the general response to the experimental manuring of young budded Rubber has been poor, but regarded from another angle it is encouraging to note that fairly satisfactory growth has been obtained without the application of manures.

3. Seedling Nursery Plants.

(a) Effect of Nitrogen, Phosphate and Potash (Pinnagoda Experiment).—Seeds harvested in the Monaragala district were planted 1 ft. by 1 ft. apart in February and manures were applied in April, July, October and December. At each application the manurial treatments were: control, single nitrogen (.30 oz. ammonium sulphate), double nitrogen (.60 oz. ammonium sulphate), potash (.12 oz. muriate of potash), phosphate (.33 oz. superphosphate) and all their combinations. There were altogether 12 different manurial treatments, and three replications.

The general growth for the year was poor, due possibly to very dry soil conditions shortly after planting and to an attack of "bird's eye-spot" disease later in the year.

When the results are treated factorially the following mean heights per plant are obtained for measurements taken in December.

No nitrogen	Single nitrogen	Double nitrogen	No phosphate	Single phosphate	No potash	Single potash
39.3 ins.	44.0	44.2	41.6	43.4	45.5	39.5
Significant Difference			Not			
	4.2 (P=.05)		significant		4.7 (P=.01)	

Nitrogen has brought about a small but significant response and potash has shown a small but significant depressing effect. It should be noted however that the ratio of K to N or P in this experiment is greater than that of our standard mixture.

(b) Effect of Different Forms of Nitrogen.—Details of planting and times of manuring are the same as in the experiment described above The nitrogenous manures applied were sulphate of ammonia, nitrate of

soda (single and double rate of application), calcium cyanamide and blood-meal at rates equivalent to 1/16 oz. nitrogen per plant. A basal dressing equivalent to 1/16 oz. phosphoric acid and 1/16 oz. potash per plant was also given to all plots. A control treatment was included which received P and K only. There are 5 replications of each treatment and the treatment plots are randomised within each block.

The mean height measurements in December were :—

No nitrogen	Nitrate of soda (single dose)	Nitrate of soda (double dose)	Calcium cyanamide	Blood-meal	Sulphate of ammonia
39.9 ins.	37.5	38.5	40.2	44.1	42.6

Responses to manurial treatments are small and not of statistical significance but the apparent inferiority of nitrate of soda to the other manures is of interest.

(c) Effect of Nursery Manuring on Transplanted Budded Stumps — Nivitigalakele Experiment.—This experiment was designed to investigate the effect of nursery manuring on the growth of transplanted budded stumps. Eighteen budded stumps (of diameter 1 1/8 in. to 1 3/8 in.) from each of the manurial plots O, N_2 P, K, NK and N_1PK of a nursery experiment similar to that described under section 3(a) were planted out in a gravelly soil, which had previously been given a basal dressing of 25 lbs. compost and 3 oz. animal meal per square yard.

Eight months after planting, the mean diameters at 4 ins. above ground level were :—

O	N_2	P	K	N_1K	NPK
.73 in.	.73	.71	.73	.79	.79

Although there is an indication of a response to an NK mixture, this is not statistically significant, and the possibility of a manurial effect, not evident in girth of the stump at budding, becoming evident in girth of the scion after transplanting, has not been given much support in this experiment.

Reference may be made to last year's report in which experimental results were given indicating that manuring of nursery seedlings had had only a slight effect on growth, but had apparently doubled the number of budding successes.

SOIL SURVEY.

During the year 13 profiles were examined on clearings and 70 soil samples taken from them for analysis.

LABORATORY WORK.

78 soil samples were taken or received during the year for advisory purposes. In addition 13 samples of compost, 8 of rubber leaves, 1 of tea dust and 1 of synthetic urea were examined. Including work of an experimental nature, 183 samples were examined in all.

ESTATE VISITS

The following visits were paid :—

Advisory	...	2
Experimental	...	5

CORRESPONDENCE.

Enquiries were dealt with on the following subjects :—

General manuring	...	97
Manuring under war conditions	...	62
Field experiments on estates	...	53
Advisory (involving soil analysis)	...	47
Time and method of applying manures	...	12
Compost	...	8
Miscellaneous	...	35
		314

LECTURES.

The following lectures were given during 1940 and were later reproduced in the Quarterly Circular :—

Venue :	*Subject :*
Rubber Conference	The Maintenance of Soil Fertility in Young Rubber Clearings.
Southern Province P.A.	Some Aspects of the Manuring of Mature Rubber

PUBLICATIONS.

The following papers were published :—

1. Field Experiments on Dartonfield Estate—XI. Manuring Experiment with Mature Rubber. Quarterly Circular, Vol. 17, Part 1 L. A. Whelan and C. A. de Silva.

2. Manuring Under War Conditions—Quarterly Circular, Vol. 17, Part 4. L. A. Whelan.

3. Field Experiments on Dartonfield Estate—XIII. Measurements of Growth in Replanted Areas, (1940) Quarterly Circular, Vol. 17, Part 4. L. A. Whelan and C. A. de Silva.

MEMORANDA.

The "Programme of Manuring for Replanted Rubber Clearings" was recast during the second quarter and published as Advisory Circular No. 2. 81 copies of the circular were despatched to enquirers during the year.

(Sgd.) L. A. WHELAN,
Soil Chemist.

Rubber Research Scheme (Ceylon),
Research Laboratories,
Dartonfield,
Agalawatta.
15th February, 1941.

REPORT OF THE SMALLHOLDINGS PROPAGANDA OFFICER FOR 1940

The free services offered to Rubber small owners by the Smallholdings Department of the Rubber Research Scheme have been availed of to a markedly increased extent during the year and official diaries of Rubber Instructors have, not infrequently, been booked up with engagements for a whole month to come. This has been due partly to increasing recognition of the utility of the services offered, and partly to the comparatively prosperous state of the Rubber market throughout the year which has enabled small owners to devote more money and attention to the improvement of their holdings and methods. The average market price of smallholders' rubber during the year was in the neighbourhood of 45 to 50 cts per lb. while the favourable prices fetched by uncouponed rubber, due to the reduced value of coupons, provided an incentive to smallholders to tap their trees.

Staff

As in 1939 the Department was represented by six Rubber Instructors under the writer's supervision and a Clerk-Translator. The Instructors were stationed at Horana, Matugama, Poddala (Galle), Ruwanwella, Katugastota and Ratnapura respectively. The appointment of an extra Instructor for the Ruwanwella range was recommended by the Smallholdings Committee towards the latter part of the year and approved by the Board, as the range was considered to be too large for one Instructor. Applications for the post were called for in November, 239 applications received and 14 applicants selected for interview. The appointment will be made early in 1941.

Visits, Meetings, Etc.

Each of the six ranges was visited supervisorily on an average once every quarter.

The Smallholdings Committee inspected the Ratnapura, Galle, Matugama, and Ruwanwella ranges during the year and thus completed a round of visits to all six ranges (Horana and Kandy having been visited in 1939). The Committee recorded its satisfaction with the work being done in each range.

An event of special interest was an informal visit to the Matugama range paid by the Honourable the Minister for Agriculture and Lands in June. During the course of a whole morning, the Minister inspected a

number of smallholdings where different types of work had been carried out under the instructions of the Department, and the visit was a source of great encouragement both to the staff and the smallholders of the range.

The Rubber Conference in Colombo in April was attended by the writer and all six Instructors, and was followed the next day by a meeting and discussion at Nivitigalakele on matters relative to the Department's work arising from papers read at the Conference.

Competitions

Judging was concluded in the competitions for the "best-kept holding" held in the Horana, Matugama, Ruwanwella, Ratnapura and Kandy ranges respectively. Judging was done by the allocation of marks for different recommended works carried out on the holdings, according to a pre-arranged schedule of marks handed to each competitor at the start of the competition. Improvements in sheet making, soil conservation measures, tapping, compost-making etc. were generally very satisfactory considering that the competition was the first of its kind in all but the Horana range. The work done in the Horana competition was of a particularly high standard, the quality of sheet produced in several cases being exceptional and comparing favourably with the very best Ceylon estate sheet. The writer was assisted in judging the Horana competition by the Acting Director and Mr. W. P. H. Dias, member representing smallholders on the Board, who also kindly offered a special prize for the best sheet in the Kalutara district. The competition in the Galle range was abandoned owing to lack of enthusiasm among the competitors, some of whom were severely affected by the serious floods in May.

Formal prize-givings were organised in respect of the above competitions in the Horana (for both Horana and Matugama competitions) Ratnapura and Ruwanwella ranges respectively, at which Rubber small owners of the range, besides the prize-winners, were assembled by notice. The Government Agent usually presided and prizes were distributed by the Director. Certificates of merit were awarded to non-prize-winners who reached a high standard. On each occasion the writer gave a talk in Sinhalese on a subject pertaining to the work of the Department and other matters of present interest to Rubber small owners. The prize-giving at Ruwanwella was held jointly with the Annual Training Class of the Co-operative Department and over a thousand people were present. The prize-giving for the Kandy competition will be held in early 1941. The competitions, it is felt, are serving a useful purpose in inculcating into small owners methods of cultivation, management and manufacture which would normally take more time and effort to popularise.

Coagulants

The position regarding coagulants (mainly acetic acid) available to small owners for coagulating their latex was generally unsatisfactory during the year. Although import statistics showed ample quantities of acid available in the Island for the needs of the Rubber industry for the entire year, smallholders found themselves, more often than not, having to pay excessive rates for their acid to local dealers and sometimes buying impure or diluted acid in spite of it. Actual samples tested from time to time were found in a number of cases to be contaminated with substances like sulphuric acid, and being sold at about 4 times their actual value and, in other instances, to be weak in strength probably due to addition of water. Some of these were being sold by dealers under various proprietary names and others as acetic or formic acid. Numerous cases where smallholders' sheets had been spoilt by the use of unsuitable acids were observed during inspections. Certain dealers on being asked the reason for the unreasonably high rates charged for acid as compared with Colombo prices complained that they experienced great difficulty in procuring acid from Colombo. Although some truth was found in this statement due to Colombo firms reserving stocks for their regular big customers, it was found to be exaggerated and used as a subterfuge for their (dealers') profiteering. Arrangements were accordingly made with certain Colombo firms to supply good acid at reasonable prices to dealers who applied for it and the information was circulated through the Instructors and the Press. No appreciable improvement in the situation, however, followed. The following suggestions were therefore made by the writer :—

1. Re-introduction of control of prices of acetic and formic acids.

2. Reserving suitable proportion of acids for supply to small proprietors.

3. Making it compulsory for dealers to give receipts stating name, strength, price and quantity in respect of every sale of acid and to retain counterfoils.

4. Providing Rubber Instructors with the necessary authority to inspect dealers' books and test their acid.

The Food Controller and Controller of Prices was interviewed by the Director and the writer and the problem discussed, but there appeared to be objections to most of the remedies suggested. After further consideration by the Smallholdings Committee, it has since been decided by the Board that the following recommendations should be made to the authorities concerned.

1. That imports of sulphuric and other mineral acids should be prohibited except under permits granted for purposes other than rubber coagulation.

2. That stocks of coagulants should be controlled while supplies are plentiful, so that price and other restrictions could be enforced without delay in the event of a shortage developing.

It was also agreed that approved dealers should be appointed by the Smallholdings Department in small towns and villages who would undertake to buy their stocks of acid in sealed bottles from Colombo firms at rates arranged by the Department and retail them at approved rates, and that Rubber Instructors should direct smallholders to these dealers.

Reports received from Malaya show that a similar situation has arisen there and is being dealt with by the adoption of recommendation 1 above.

The simple acid testing sets provided by the Chemist have been very useful in detecting undesirable coagulants. These provide tests for determining formic acid and the presence of impurities of sulphuric acid but, unfortunately, have no positive test for acetic acid. Each Instructor possesses one of these sets.

Joint Work with Co-operative Department

In view of the prevalent difficulties experienced by Rubber smallholders in carrying out the recommendations of this Department for want of funds and proper organisation, the possibilities of doing some work jointly with the Co-operative Department for the benefit of smallholders were discussed with the Deputy Registrar of Co-operative Societies. The Registrar who was most sympathetic towards the idea thought that there was considerable scope for such work, but explained that Government was not able at present to provide funds for the additional staff that would be required. He however, offered to assign a trained officer from the Co-operative Department to do special work in this connection under our joint supervision, if the Rubber Research Scheme was prepared to finance him. A similar arrangement had recently been made, he said, with the Coconut Board.

As an alternative to this suggestion which necessitated the financing of a special officer, written proposals for carrying out a similar work on an experimental basis through existing Co-operative Credit Societies in prominent Rubber districts, were submitted to the Registrar. A trial could be made with one society first. The suggestion was that Rubber owning members of an existing Co-operative Credit Society should, with funds obtained from their Society, combine co-operatively to prepare, smoke and market their rubber sheet by building and using a common smoke-house, utensils, rollers, etc. and should share the nett profits on a *pro-rata* basis. The local Co-operative Inspector and the Rubber Instructor could supervise such work of this sub-society, as it were, as falls within their respective spheres. If successful the scheme could be

extended to comprise the improvement of not only smallholders' sheet but general conditions on Rubber holdings. The Registrar's views on the proposal are being awaited and further steps will be taken in 1941.

The Rubber Instructor, Matugama, was instrumental in getting the members of various Co-operative Societies in his range to order carboys of acetic acid direct from Colombo and share the cost. To give one example, the inclusive cost per bottle in this way worked out at Rs. 1-41 as compared with Rs. 2 to Rs. 2-50 being charged at the time by local dealers for acid whose purity was not guaranteed.

Replanting

(a) General.—In spite of the attractive rubber prices that prevailed during the year, which do not act as an inducement to smallholders to cut down their income-yielding Rubber and replant, appreciable activity in replanting prevailed, the largest number of holdings replanted being in the Ruwanwella range. The policy during the year, where possible, was to get only the more poorly grown and badly tapped areas in smallholdings replanted and to leave the better area to bring in income and the usefulness of this idea is being realised. The Instructors lined for holes or drains, or both, a total of 149 holdings (242 acres), but of which planting was completed with budded stumps or seedlings on 122 holdings (193 acres). Other replanting work such as felling, clearing, cutting holes and drains, filling holes, planting covers etc. was done on 126 holdings (234 acres). The recommended measurements for contour drains were altered from 2 ft. deep and 1½ ft. wide to 1½ ft. deep and 2 ft. wide.

A number of recently replanted areas was damaged by the floods in May and June particularly in the Hanwella area, in some cases well-grown budded plants 6 ft. high having been completely submerged for 5—7 days. Some of these had died completely and others down to brown wood. The planting of stumped buddings was recommended for such areas in future and available supplies were issued to owners who had suffered damage at reduced rates. The provision by the Research Scheme of limited quantities of stumped buddings to smallholders annually was recommended.

There was no reduction in coupons in respect of areas cut down for replanting during the year.

(b) Demonstrational.—The six demonstration replanted blocks in the respective ranges were weeded, manured and maintained in good order. Covers have been satisfactorily established. The annual average girth measurements at 3 ft. were taken and are given overleaf. Except in the Ratmalgoda block which received an early set-back due to the owner's neglect, the growth in all the blocks, it will be noted, is very satisfactory, that in the Galle and Ratnapura blocks being exceptional. Considering that no fertiliser other than cattle or compost manures has been added and that the blocks are 1/2 acre ones surrounded on two or more sides by mature Rubber, the figures are particularly interesting.

Block	Date planted	No. of plants & clone	Approximate age	Average girth per plant
Horana Range Kahatapitiya	29.10.37	75 of Tj. 1	3 years	7.21″ on 4.11.40.
Horana Range (Ratmalgoda)	1.11.37	116 of PB. 25	3 years	5.74″ on 5.11.40.
Matugama Range	3. 6.38	53 of Gls. 1 20 of BD. 5	2½ years	6.33″ on 4.12.40.
Ruwanwella Range	— — — —	block abandoned	— — — — — —	
Galle Range	3.11.38	80 of PB. 86	2 years	6.5″ on 30.11.40
Kandy Range	15.12.38	75 of PB. 25	2 years	5.05″ on 11.12.40
Ratnapura Range	11.12.37	73 of Tj. 1	2 years	6.83″ on 6,1.40

The demonstration block at Ruwanwella was abandoned owing to continued neglect on the part of the owner to maintain it in normal order in terms of the agreement signed by him.

Planting Material

4,670 budded stumps and 2,188 yards of budwood were issued to small owners from the Nivitigalakele nurseries at the usual rates. An additional 2,116 budded stumps were issued from demonstration nurseries in the ranges. 532 stumped buddings were issued to owners whose plantations had suffered flood damage, at the reduced rate of 25 cts. each. 319 yards of budwood were issued to Rubber Instructors from Nivitigalakele for budding demonstration nurseries, and 20 stumped buddings for supplying vacancies in demonstration replanted blocks. The work of allocation, collecting payment and issue of this material monopolised a considerable portion of the writer's time in office besides adding very considerably to the clerical duties of the Clerk-Translator. The demand for budded stumps was far in excess of the supplies available and preference had to be given, in allocating, to replanters as distinct from new-planters, for whom the provision of planting material was being arranged by the Department of Agriculture. Available stocks of budwood, however, were in excess of the demand and no distinction in allocating was therefore made.

Numerous applications for clonal seed were received but could not be met as the Research Scheme has no facilities for providing this material at present.

Issues of all planting material were confined, as in 1939, to owners whose total Rubber acreage did not exceed 30 acres. The writer, however, possesses no means at present of verifying the acreage of an applicant who may choose to represent himself as a smallholder by an incomplete declaration of his properties. Such verification will be all the more necessary in 1941 when material will be issued at specially reduced rates to owners of a total Rubber acreage of 5 acres and less, and it is hoped that some arrangement can be made with the Rubber Controller to make verification possible.

Smokehouses and Smoking

The improved rubber market resulted in an increased demand for the Instructors' help in erecting the cheap and efficient little "wattle-and-daub" smokehouses designed and recommended by the Department. The Instructor lines the ground for each house, supplies the plan and a list of timber and material required, and supervises the construction. A total of 109 such smokehouses was started during the year and 82 houses (including 22 started in 1939) were completed. 19 existing houses were improved, mainly by the re-arrangement of the racks inside and the provision of inlet and outlet ventilation. 7 demonstration houses were started and 14 (including 8 started in 1939) were completed.

Every effort was made to improve the quality of smallholders' sheet by demonstrations, competitions, publications and other propaganda, particularly in view of the opportunity afforded by the improved rubber market. 104 sheet making demonstrations were given. A fair number of owners is producing distinctly better sheet through the Instructor's endeavours and remarkable improvement has been achieved in a number of isolated cases, but the problem is a vast one and only its fringe has so far been touched. A great inducement towards the improvement of smallholders' sheet would be the purchase of sheet by local dealers *by grading*, which unfortunately hardy exists at present. Correspondence was had with the Commissioner for Agricultural Marketing regarding the launching of a previously discussed scheme for appointing approved local agents in small towns for purchasing smallholders' sheet by grading with maximum benefit to the producers.

The design for a larger smallholders' smokehouse to hold approximately 800 lbs. of rubber at a time was prepared by the Chemist at the writer's request, and plans and estimates were prepared. The house would be useful for groups of smallholders or Co-operative Societies that may desire to own and use a smokehouse on a co-operative basis. There is thus a range of 4 sizes of inexpensive smokehouses available to smallholders, of 18, 120, 350, and 800 lbs. capacity respectively. The first two cost only Rs. 8-50 and Rs. 15 to build if the owner does the work himself which is very simple, while the largest one costs Rs. 225 including labour.

Approximately 100 sq. ft. of monel metal mesh were sold to smallholders by Instructors at the special rate of Rs. 1-50 per sq. ft. (actual cost being Rs. 2-25 per sq. ft.) with a view to popularising its use. This mesh is recommended by the Research Scheme in preference to brass mesh, which tends to contaminate the latex and is less durable. The demand from smallholders has been satisfactory and is likely to be keener.

Propaganda, Publications, Etc.

The Department's poster was printed early in the year and suitably distributed, and now forms a well-known sign at prominent places in most Rubber districts in the Island.

There was a greatly increased demand for the 3 leaflets issued by the Department in Sinhalese and English on "Replanting of Rubber," "Budding," and "Preparation of Smoked Rubber Sheet" respectively, and discretion had to be used in their free issue in view of the higher costs of paper and printing. All 3 leaflets were revised and reprinted, as the original stocks were exhausted.

The Department participated in the Bopitiya Health and Rural Reconstruction Exhibition by request, and ran a stall displaying smallholdings exhibits.

The following addresses were given by the writer to assemblies of smallholders :—

1. "The Work of the Smallholdings Department," at the Bopitiya Exhibition on July 25th.

2. "Subjects of present interest to Rubber small owners," at the prize-giving in connection with the Horana and Matugama competitions at Horana on October 30th.

3. "Subjects of present interest to Rubber small owners," at the Ratnapura competition prize-givng at Pussella on December 10th.

4. "Possibilities of joint work between the Co-operative Department, Ceylon, and the Smallholdings Department of the Rubber Research Scheme for the benefit of Rubber small owners," at the joint Ruwanwella competition prize-giving and Annual Training Class of the Co-operative Department at Pindeniya on December 21st.

Compost

The demonstration compost pits were maintained in each range to demonstrate the simple preparation of compost. Compost was made in these throughout the year, and used for demonstration nurseries and replanted blocks. 84 private compost pits were opened by smallholders on the Instructors' advice.

Two samples of compost made by the Horana Instructor using different green materials were analysed by the Soil Chemist for comparison of the nutrient contents. The first sample consisting of roughly equal parts of cattle manure, bowitiya leaf *(Osbeckia octandra)* and kaduru leaf *(Cerbera odollam)* was found to contain .71% nitrogen, .22% phosphate and .11% potash, whereas the second consisting of cattle manure, gliricidia leaf and boga leaf *(Tephrosia candida)* in the approximate proportion of 2 : 1 : 1 contained .81% nitrogen, .74% phosphate and .24% potash. The former is low in phosphate and very low in potash while the latter is satisfactory. The superiority of the latter was probably mainly due to the type of green material used.

Nurseries

Budding demonstrations were started in the demonstration nurseries (14) in the Ruwanwella, Galle, Kandy and Ratnapura ranges, and the successfully budded plants were sold to smallholders as budded stumps. Similar demonstrations (started in 1939) were continued in the nurseries in the Horana and Matugama ranges. Facilities for practising budding were provided for learners in the section of each nursery assigned for that purpose. All nurseries were weeded, thinned, manured and maintained in proper order. New nurseries were established in place of those whose plants would be too old for budding in 1941. Ten such new demonstration nurseries were established. 16 nurseries were opened by private owners.

Budding Instruction

Three 6-day courses of instruction in budding were given to a total of 27 smallholders by the Budding Instructor at Nivitigalakele. Certificates are issued to those who obtain satisfactory results in their final budding test.

Demonstrations

Particulars of practical demonstrations given by the Rubber Instructors to groups of smallholders appear in the summary of work appended to this report. The number of demonstrations, however, has had to be limited in view of the increased advisory and other work that Instructors have been called upon to undertake.

Correspondence

The correspondence for the year was as follows :—

Inward	...	...	1,625
Outward	...	...	1,587

A typewriter for Sinhalese characters, which was recently introduced on the local market, was purchased for the office. Although the letters

are somewhat large and typing has necessarily to be much slower than with its English counterpart, the production is a most commendable effort

Summary of Work

The "summary of work" appended to the end of this report indicates in concise form the work done by each Rubber Instructor during the year. For want of space only some of the work done is shown under "other main work."

(Sgd.) W. I. PIERIS,
Smallholdings Propaganda Officer.

Nivitigalakele,
Matugama,
February, 1941.

D=Demonstrational
O=Other

Summary of Work

Instructor	DEMONSTRATIONS					SMOKEHOUSES			HOLDINGS REPLANTED			Nurseries	Compost pits	Other Main Work
	Sheet Making	Budding	Marking & Tapping	Disease Treatment	Other	Started	Completed	Improved	Lined for holes or drains or both	Other work	Completed			
1. Rubber Instructor, Horana	17	31	5	2	111	13 (O)	12 (O)	5	25 (O) (39 Acs.)	25 (O) (39 Acs.)	20 (O) (31 Acs.)	3 (D) 5 (O)	3 (D) 9 (O)	1,168 plants budded in nurseries. 653 plants issued from nurseries. 16 sq. ft. monel mesh sold. 3 private nurseries budded. 6 mature holdings silt-pitted. 9 mature holdings contour-drained. 15 talks *re* work of Department
2. Rubber Instructor, Matugama	12	17	7	6	33	3 (D) 20 (O)	4 (D) 10 (O)	5	21 (O) (25 Acs.)	18 (O) (25 Acs.)	14 (O) (29 Acs,)	3 (D) 5 (O)	16 (O)	184 plants budded in nurseries. 255 plants issued from nurseries. 14½ sq. feet. monel mesh sold. 5 mature holdings contour-drained. 7 carboys of acid ordered for Co-operative Societies. 13 meetings attended and talks given.
C. forward .	29	48	12	8	144	3 (D) 33 (O)	4 (D) 22 (O)	10	46 (O) (64 Acs.)	43 (O) (64 Acs.)	34 (O) (60 Acs.)	6 (D) 10 (O)	3 (D) 25 (O	

Instructor	DEMONSTRATIONS					SMOKEHOUSES			HOLDINGS REPLANTED			Nurseries	Compost pits	Other Main Work
	Sheet Making	Budding	Marking & Tapping	Disease Treatment	Other	Started	Completed	Improved	Lined for holes or drains or both	Other work	Completed			
B/Forward ...	29	48	12	8	144	3 (D) 33 (O)	4 (D) 22 (O)	10	46 (O) (64 Acs.)	43 (O) (64 Acs.)	34 (O) (60 Acs.)	6 (D) 10 (O)	3 (D) 25 (O)	
3. Rubber Instructor, Galle	8	22	13	15	27	1 (D) 10 (D)	3 (D) 11 (O)	1	26 (O) (41 Acs.)	20 (O) (36 Acs.)	21 (O) (33 Acs.)	2 (D) 2 (O)	11 (O)	1,001 plants budded in nurseries. 543 plants issued from nurseries. 17 sq. ft. of monel mesh sold. 1 acre lined for vacancies. ½ acre mature Rubber contour-drained. 18 R. C. 29 forms filled.
4. Rubber Instructor, Ratnapura	38	130	24	20	48	2 (D) 17 (O)	2 (D) 10 (O)	3	9 (O) (23 Acs.)	3 (O) (15 Acs.)	7 (O) (12 Acs.)	4 (O)	27 (O)	1,213t rees budded. 21 sq. ft. of monel mesh sold. 14½ acres mature Rubber lined for drains. 19 R. C, 29 forms filled,
C/Forward ...	75	200	49	43	219	6 (D) 60 (O)	9 (D) 43 (O)	14	81 (O) (128 acs.)	66 (O) (115 acs,)	62(O) (105 acs.)	8 (D) 16 (O)	3 (D) 63 (O)	

Instructor	DEMONSTRATIONS					SMOKEHOUSES			HOLDINGS REPLANTED			Nurseries	Compost pits	Other Main Work
	Sheet Making	Budding	Marking & Tapping	Disease Treatment	Other	Started	Completed	Improved	Lined for holes or drains or both	Other work	Completed			
B/Forward: ...	75	200	49	43	219	6 (D) 60 (O)	9 (D) 43 (O)	14	81 (O) (128 acs.)	66 (O) (115 acs.)	62 (O) (105 acs.)	8 (D) 16 (O)	3 (D) 63 (O)	
5. Rubber Instructor, Ruanwella	17	11	1	2	24	1 (D) 24 (O)	2 (D) 20 (O)	—	35 (O) (61 Acs.)	35 (O) (69 Acs.)	32 (O) (46 Acs.)		13 (O)	3 acres budded. 4 flood damaged areas planted with stumped buddings. 7 talks given at smallholders' meetings. 23 R. C. 29 forms filled.
6. Rubber Instructor, Katugastota	12	12	3	—	29	25 (O)	3 (D) 19 (O)	5	33 (O) (53 Acs.)	25 (O) (50 Acs.)	28 (O) (42 Acs.)	2 (D)	8 (O)	319 plants budded in nurseries. 40 plants issued from nurseries. 7 acres lined for contour drains 210 plants budded in holdings. 10 acid samples tested. Forwarded 37 R.C. 29 & 6 new planting applications
Total...	104	223	53	45	272	7 (D) 109 (O) 116	14 (D) 82 (O) 96	19	149 (O) (242 acs.)	126 (O) (234 acs.)	122 (O) (193 acs.)	10 (D) 16 (O) 26	3 (D) 84 (O) 87	

ESTATE SUPERINTENDENT'S REPORT FOR 1940

The writer, Mr. G. P. N. de Silva, took charge of the Scheme's estates on the 18th September, 1940.

DARTONFIELD ESTATE.

Acreage Statement and Census.

No. of Field	Date of planting	Acreage	No. of Immature trees	No. of Mature trees	Total	No. of trees per acre
Mature Areas—						
1	1910	29.2.15	22	2,867	2,889	97
2	1913	0.3.36	—	75	75	75
3	1917	30.2.04	—	2,866	2,866	94
4	1911	1.1.03	—	174	174	140
6	1913	58.2.10	—	5,412	5,412	93
	Total	120.3.28	22	11,394	11,416	95
Replanted Areas—						
1	1934	7.3.07	831	—	831	111
2	1938	12.2.10	1,395	—	1,395	111
2a	1938	6.2.35	800	—	800	123
3	1936	9.1.10	1,226	—	1,226	129
4	1939	2.0.00	222	—	222	111
	Total	38.1.22	4,474	—	4,474	116
Total Rubber		159.1.10	4,496	11,394	16,890	100
Buildings & roads		14.3.08				
Scrub etc.		2.2.19				
Grand Total		176.2.37				

Rainfall.—151.39 inches.

Rainfall was below average. There was a drought at the beginning of the year and a prolonged South-West Monsoon. The North-East Monsoon was very unfavourable for crop intake. Details of rainfall during 1940 and the preceding year appear below :—

	1939	1940
January	6.72 ins.	0.80 ins.
February	3.87 „	4.23 „
March	4.15 „	3.93 „
April	10.69 „	13.86 „
May	25.17 „	25.30 „
June	17.99 „	16.34 „
July	9.73 „	7.94 „
August	27.89 „	11.20 „
September	14.05 „	9.26 „
October	26.40 „	28.95 „
November	21.68 „	23.61 „
December	6.87 „	5.97 „
Total	175.21 ins.	151.39 ins.

Crop.—Crop for the year amounted to 65,503 lbs. against an estimate of 70,000 lbs. The shortfall may be partially attributed to the very dry weather conditions in the first few months of the year, and to interference of rain with tapping in later months. The conditions are very similar to those experienced in 1939.

Yield records for individual fields are as follows :—

Field No.	Date of Planting	Total Crop lbs.	Acreage Tapped	Yield Per Acre lbs.
1	1910	15,535	28½	545.1
2	1913	883	1	883.0
3	1917	16,625	30½	545.1
4	1911	1,207	1½	804.7
6	1913	31,253	58½	534.2
	Total	65,503	120	545.9

Percentage of estimate harvested—93.6%.

Crop figures for the Forestry area, which forms part of Field No. 1, are as follows :—

	1939.	1940.
January-June	4,852 lbs.	5,101 lbs.
July-December	7,457 „	7,914 „
Total	12,309 lbs.	13,015 lbs.

Tapping.—Tapping remained on the double-four system. Bark consumption averaged 3¼ ins. on each cut.

The tapping in experimental areas was under the supervision of the Estate Superintendent as in former years.

Average Intake per Tapper

	1939	1940
January	9.0 lbs.	7.4 lbs.
February	7.0 „	4.8 „
March	3.2 „	5.1 „
April	7.1 „	8.2 „
May	8.4 „	7.7 „
June	7.8 „	10.3 „
July	9.5 „	9.4 „
August	9.2 „	11.3 „
September	7.7 „	9.9 „
October	8.1 „	9.3 „
November	9.1 „	10.4 „
December	11.3 „	9.8 „

Tapping in Area Selected for Replanting in 1941.—As mentioned in last year's report, heavy tapping was started in this area in December, 1939, on the "double-three' system and continued until the resting period. In March, the cuts were re-opened on the "double-two" system and continued until the end of the year, an extra cut being opened on each side of each tree on 20th November. The yield for the complete year amounted to about 860 lbs. per acre.

Determination of Individual Yields.—This work is being continued for the purpose of selecting suitable mother trees.

Manufacture.—Production of smoked sheet was limited during the early part of the year but, later on, this was made good when the price of this grade rose over that of crepe. As there was an increased demand for latex from India this form of manufacture was given precedence over the others, additional latex being purchased from a neighbouring estate for the purpose. Details of grades are as follows :—

Grades		lbs.	Per cent	Total
Smoked Sheet No. 1	...	16,949	25.87	26.30
„ „ 2	...	284	43	
Latex Crepe No. 1	...	19,577	29.89	34.39
„ „ 2	...	2,208	3.37	
„ „ 3	...	741	1.13	
Scrap Crepe No. 1	...	3,484	5.32	12.90
„ „ 2	...	3,975	6.07	
„ „ 3	...	988	1.51	
Latex	...	17,297	26.41	26.41
Latex bought from an outside estate		11,052 lbs.		

Machinery.—Machinery and electrical equipment were inspected in February by Messrs. H. W. Hammond & Co., Consulting Engineers, who reported satisfactorily on their condition.

The Ruston Hornsby engine was decarbonised twice and the Lister engine once during the year. The latter was fitted with a new cylinder lining.

The rolls of the smooth creping mill were refaced during the resting period. Minor improvements were effected to the hot-air radiator in the crepe drying room by the erection of a cowl with baffle plate and new air intake pipe. Both the settling tanks in the factory were lined with white glazed titles.

Details of fuel consumption are given below :—

	Large Engine (Ruston Hornsby 52-57 h.p.)			Small Engine (Lister 9 p.m.)		
	Hours worked	Diesel oil, gals.	Lubric. oil, gals.	Hours worked	Diesoline gals.	Lubric. oil, gals
1940	2,736	3,610	263	1,701	584	44
Average per hour		1.32	.10	—	.34	.03
1939	2,278	2,667	245	1,914	816	93
Average per hour		1.17	.11	—	.42	.05

Pests and Diseases.—

Oidium Leaf Disease.—Oidium infection was very light, owing to weather conditions being unfavourable for the incidence of the disease, the late wintering trees being the only ones affected. One complete and 3 partial

rounds of sulphur dusting were carried out, and consisted of a total application of approximately 13 lbs. of sulphur per acre. A certain amount of Phytophthora secondary leaf-fall was noticed in parts of the estate.

4 cases of *Fomes lignosus*, 8 cases of Brown Root, 2 cases of Ustulina and 1 of *Poria Hyprobrunnea* were detected in the mature area. Routine methods of control were adopted.

10 trees were blown down during the heavy monsoon storms in May.

Application of Cargillineum mixture A and a 3% solution of Izal to tapping cuts was carried out in wet weather as protection against bark rot.

The following is a census of thin bark trees taken in conjunction with the determination of yields of individual trees :—

Field No.	Both sides	One side	Total	Per cent.
1	96	175	271	9.45
2	4	4	8	10.67
3	49	105	154	5.37
4	2	5	7	4.23
6	116	223	339	6.26
Total	267	512	779	6.84

86 unproductive trees were thinned out during the year.

Experiment with Bark Stimulants.—An experiment was commenced to study the effect of application of the undermentioned oils on renewing barks :—

Palm oil, Mee oil, Cargillineum base, Coconut oil.

A tapper's block near the factory was divided into groups of 5 trees each and one tree in each group allotted at random to each treatment. The oils are being applied to the recently tapped cortex in a thin smear approximately once a month.

Cultivation.—Manuring was completed in accordance with the programme detailed for the year. 60 acres of mature Rubber were treated with 400 lbs. of fertiliser mixture per acre composed of 6 parts calcium cyanamide, 2 parts mineral phosphate and 1 part muriate of potash. The fields treated consisted of 22 acres Forestry area in field No. 1 (2nd cycle) and 28 acres in field No. 6 (3rd cycle). Manure was broadcast between the rows during February and March.

Weeding.—The control of natural covers and selective weeding were carried out as in previous years.

Foresty Area.—The control of both ground and erect covers was carried out according to requirements.

Cover Crops.—There is a very good cover of *Pueraria phaseoloides* over most of the estate.

Labour.—The labour force of Tamils was adequate for normal estate requirements. There was a shortage of tappers during September owing to the harvesting season. 3 Sinhalese families, mostly tappers, are now living on the estate and seem to have settled down.

The payment of a temporary war bonus to labourers was made with effect from 1st March. The method of payment was calculated on the basis of daily out-turn at 4 cents per man, 3 cents per woman and 2 cents per working child with a monthly maximum of Re. 1, 75 cents and 50 cents respectively.

The Labour Inspector visited the estate on the 26th July and inspected the books.

The health of the labourers has been moderately good. A severe outbreak of Malaria was experienced in May. 19 cases were reported amongst the resident labourers and bungalow servants accommodated in lines on the estate. A few cases also occurred amongst members of the staff and their families. Spraying buildings with insecticide was continued during April and May in addition to oiling of small streams. Dr. Svensson, Medical Officer of the Malarial Control Scheme visited the estate and reported on the outbreak.

Mass hookworm treatment was administered to the labour force by the Field Officer on the 17th July

Monthly Total of Labour on Check-roll.

	Tamils	Sinhalese	Total
January ...	37	29	66
February ...	35	34	69
March ...	35	44	79
April ...	34	47	81
May ...	33	41	74
June ...	33	33	66
July ...	33	54	87
August ...	38	57	95
September ...	33	71	104
October ...	34	75	109
November ...	34	70	104
December ...	32	59	91

Figures for daily out-turn and daily rate of pay are as follows :—

Average daily out-turn	...	49
Average wages per day	...	51.93 cents.

Experimental Areas.—

No. 1	Area replanted in	1934	...	7½ acres
„ 2	„	„	1935 and 1938	12½ „
„ 2a	„	„	1938 ...	6½ „
„ 3	„	„	1936 ...	9½ „
„ 4	„	„	1939 ...	2 „

The Estate Superintendent exercised supervision of routine work in the different clearings, in accordance with the instructions of the Technical Officers.

Area No. 5—1941 Replanting.—The felling of a block of about 7 acres of mature Rubber is in progress.

Buildings.—Maintenance of buildings which comes within the purview of the Estate Department, received attention.

Labourers' Quarters.—The recommendations of the Inspecting Medical Officer were undertaken during the year, except for water supply which will be attended to in 1941.

Replastering of the walls of quarters taken over when the estate was acquired by the Board, was undertaken.

Cart Roads and Paths.—Cart roads were maintained in reasonably good order throughout the year. 3 short stretches of the approach road subject to erosion were metalled. 4 corners of the estate road were also metalled and an application of Colas made.

NIVITIGALAKELE EXPERIMENT STATION

Acreage Statement.—

Nivitigalakele Division—

1926 Clearing	...	...	12½ acres
1927 „	...	...	16¼ „
1928 „	...	...	31 „
1940 Replanting	...	...	3 „
Nurseries, buildings, gardens etc.		...	6¾ „
		Total	69½ acres

Pinnagoda Division—

1935 Clearing	...	...	28½ acres
1939 „	...	...	9½ „
1930 „	...	...	10 „
Budwood Multiplication Nursery		...	6½ „
1935 Seedling Nursery	...	...	1 acre
1936 „ „	...	...	2 acres
Food crops	...	...	3 „
Uncultivated	...	...	39½ „
		Total	100 acres

Rainfall.—137.49 inches.

Crop —The crop harvested for the year amounted to 25,986 lbs. 76% of the crop was derived from areas in commercial tapping and the remainder from areas in test-tapping. The following is a summary of yield records for each field :—

Clearing	Acreage in tapping	Crop lbs.	Yield per acre lbs.
1926 Clearing ...	12½	7,345	587.6
1927 „ ...	16¼	8,753	538.6
1928 „ ...	31	9,134	294.6
1935 „ ...	3	754	251.1
Total	62¾	25,986	414.1

Tapping.—Tapping was carried out in accordance with the requirements of the Botanical Department. Figures denoting the number of trees in tapping etc., are given below :—

Field & Clearing	Test-tapping	Commercial tapping	Immature and/or not in tapping	Total
1926 Clearing ...	189	1,008	66	1,263
1927 „ ...	72	1,412	84	1,568
1928 „ ...	901	1,313	385	2,599
	1,162	3,733	535	5,430

Manufacture.—Crop from commercially tapped areas was manufactured in the form of smoked sheet. Test-tapping samples were milled at Dartonfield and sold as scrap crepe. The distribution of grades is as follows :—

Grades	lbs.	Per cent.	Total
Smoked Sheet No. 1 ...	16,937	65.18	
„ „ 2 ...	840	3.23	69.08
„ „ 3 ...	173	.67	
Scrap Crepe No. 1 (mainly test-tapping samples)	6,864	26.41	
„ „ 2	601	2.31	29.15
„ „ 3	112	.43	
Latex Crepe No. 3 do	459	1.77	1.77

Pests and Diseases.—Weather conditions were not favourable for the activities of Oidium, and consequently the majority of clones escaped infection. A few late wintering clones, however were affected. 3 complete and 2 partial rounds of dusting were carried out, involving a total application of 11 lbs. per acre.

34 unproductive trees were cut out during the year.

Manuring.—Manuring of the Nivitigalakele Rubber was completed in August and consisted of the application of the following fertiliser mixture at 200 lbs. per acre :—

Calcium cyanamide	...	12 parts
Bone meal	...	2 „
Mineral phosphate	...	4 „
Muriate of potash	...	1 part

In the 1926, 1927 and 2-acre field of the 1928 Clearing, where the general growth of ground cover is poor, manure was lightly dibbled in between the rows of plants. In the remainder of the 1928 Clearing the manure was broadcast over the cover crop between the contour rows of plants, excluding the upper bund, and lightly brushed off the leaves to prevent scorching. In steep areas, application was restricted to platforms only.

Cover Crop.—Cuttings of *Desmodium ovalifolium* were planted out in the 1927 and 1928 Clearings during the year.

Instruction in Budgrafting.—10 courses of instruction in budgrafting were held for learners during the course of the year. 104 students attended.

Pinnagoda Division

1935 Clearing—28 Acres.—The plants in this clearing were manured with a complete fertiliser mixture according to schedule.

38 blocks, comprising the clones planted as budded stumps, which were allotted to a compost experiment, were manured twice during the year according to experimental requirements.

Wind Damage.—One plant which had been pollarded owing to wind damage, died back and was re-supplied with a stumped budding.

Kosgahahena 1939 Clearing—9½ Acres *(Survey).*—A survey of the entire Kosgahahena block of 34 acres, which forms part of the 100 acres leased to the Scheme, was carried out by a private surveyor.

Cultivation.—The budded stumps in this area were manured twice during the year. In April they received 4 ozs. per plant of the following fertiliser mixture :—

Sulphate of ammonia	...	4 parts
Mineral phosphate	...	3 „
Bone meal	...	1 part
Muriate of potash	...	1 „
Bone meal	...	1 „

The seedlings received 1 oz. per plant of the same mixture. The second dose of manure was given in September with the following fertiliser mixture :—

Calcium cyanamide	...	6 parts
Mineral phosphate	...	2 „
Muriate of potash	...	1 part
Bone meal	...	1 „

The buddings were manured at the rate of 8 oz. per plant and twin seedlings at 2 oz. per plant.

Sun-Scorch.—The tender shoots of 38 plants were affected by scorch owing to exposure to the sun in dry weather. 4 casualties occurred, and shading was carried out to prevent further damage.

1940 Kosgahahena Clearing—10 Acres.—An area of 10 acres jungle land was cleared and planted according to the "no burn" system. A description of the general procedure was given by the former Superintendent at the Rubber Conference held in April (See R.R.S. 2nd Quarterly Circular, 1940, p. 72).

The area was planted, according to experimental requirements with budded stumps of 36 local and imported clones, including 9 clones of the R.R.I.M. "500" series. The planting season was a favourable one, and the plants were growing well at the end of the year.

Nurseries—

Budwood Multiplication Nurseries.—The following imported clones were introduced during the year :—

K.D. 1	P.R. 107
LCB. 870	B.D. 17
P.R. 105	AVROS. 255
P.R. 106	AVROS. 352.

Only the newer clones were manured during the year with the following fertiliser mixture at the rate of 4 ozs. per plant :—

Calcium cyanamide	...	5 parts
Mineral phosphate	...	3 „
Muriate of potash	...	1 part
Bone meal	...	1 „

Seedling Nurseries.—327 seeds of clone AVROS. 185 were received from Java, out of which 245 germinated. These were planted out in beds in part of the 2-acre seedling nursery. The 1935/38 nursery formed the main source of supply of budded stumps during the year. Owing to a shortage of buddable seedlings in these nurseries 1385 stocks were purchased from a neighbouring estate and budded to meet requirements. Part of 1936-40 nursery was used for a manurial experiment by the Soil Chemist.

Sale of Budwood, Budded Stumps, Etc.—Despatches of budwood, budded stumps and stumped buddings were as follows :—

Budwood issued to smallholders	...	2,507 yards
Budwood issued to Government	...	2,054 „
Budwood issued to estates	...	426 „
Budded stumps issued to smallholders	...	2,507
Budded stumps used for experimental planting		941
Stumped buddings issued to smallholders	...	567

Budding results for the season are as follows :—

	No. budded	No. successful	Percentage successful
January ...	763	392	51
February ...	269	140	52
March ...	902	524	58
April ...	4,526	3,057	68
May ...	720	463	64
June ...	376	322	86
July ...	262	105	40
August ...	—	—	—
September ...	374	305	82
October ...	231	119	51
November ...	—	—	—
December ...	784	635	81
Total	9,207	6,062	66

Food Crop Area.—The crop of hill paddy was a complete failure owing to the severe drought in the early months of the year and subsequent ravages of the paddy fly. This crop was replanted in June with Cassava, Sorghum, Maize and Soybean. The growth of these were again unsatisfactory and a crop of only 698 lbs. of Cassava yams was harvested. It was decided not to plant further food crops in this area and the beds will be sown with Crotalaria.

1941 Kosgahahena Clearing—14 Acres.—Preliminary operations were undertaken in the area which is to be cleared without burning in 1941. The clearing of rentices was completed and the holes were cut in No. 1 area (7 acres). Semi-circular platforms (5 ft.) are being cut in half the area and continuous platforms (3 ft.) in the other half.

WAGOLLA

Budded Rubber Area.—Routine visits were paid by the Nivitigalakele Conductor, and inspections were made by the Superintendent in June and November.

Crop amounted to 2,244 lbs. which corresponds to a yield of approximately 12 lbs. per tree. 3 trees were blown down during the year.

A cover of *Pueraria phaseoloides* is well established over the whole area.

(Sgd.) G. P. N. DE SILVA,
Superintendent.

Dartonfield Estate,
Agalawatta,
19th February, 1941.

Analysis of Tapping Rounds.

(Figures for 1939 are shown in brackets)

	Early tapping	Late tapping before 10 a.m.	Very late tapping	Partial washout	Washout	No tapping due to		
						Rain	**Rest**	**Holidays**
January	31 (26)	— (2)	—	—	—	— (1)	—	— (2)
February	4 (6)	—	—	—	—	—	25 (22)	—
March	30 (31)	1	—	—	—	—	—	—
April	22 (22)	4 (4)	1 (3)	— (1)	—	— (1)	—	3 (—)
May	16 (19)	— (2)	7 (3)	5 (4)	2 (—)	7 (6)	—	1 (1)
June	14 (15)	1 (1)	7 (9)	4 (2)	— (2)	8 (5)	—	—
July	25 (19)	— (3)	4 (6)	3 (4)	— (1)	1 (3)	—	1
August	23 (25)	—	5 (3)	— (1)	—	3 (3)	—	—
September	22 (18)	1 (1)	6 (8)	1 (4)	—	1 (3)	—	—
October	17 (14)	— (2)	7 (9)	1 (4)	1 (—)	7 (6)	—	—
November	14 (19)	2 (1)	10 (5)	1 (1)	— (2)	4 (5)	—	—
December	28 (27)	2 (1)	1 (3)	—	—	—	—	—
	246 (241)	11 (17)	48 (49	15 (21)	3 (5)	31 (33)	25 (22)	5 (3)

AUDITOR-GENERAL'S REPORT FOR 1940

Audit Office,
Colombo, March 31, 1941.

The Chairman,
Board of Management,
Rubber Research Scheme,
Peradeniya.

Sir,

I have the honour to furnish my report on the audit of the accounts of the Rubber Research Scheme for the year 1940 and to forward the following documents duly certified :—

(*a*) Dartonfield Estate Working Account for the year, 1940
(*b*) Nivitigalakele Experiment Station Working Account for the year, 1940.
(*c*) Sales Account of Vulcanised Rubber Products for the year, 1940.
(*d*) Income and Expenditure Account for the year, 1940.
(*e*) Capital Account and General Balance Sheet as at December 31, 1940.
(*f*) Statement of Receipts and Payments of the Officers' Provident Fund for 1940, administered by the Board of Management.
(*g*) Revenue Account, Dividend Account and Balance Sheet of the Officers' Provident Fund administered by the Board of Trustees.

I. INCOME

2. The total income which accrued during the year amounted to Rs. 294,502. It exceeded the estimate of Rs. 212,975 by Rs. 81,527 and the income of the previous year by Rs. 79,764.

3. The following is a comparison between the estimate and the actual income under the different accounts for the year under review :—

Account	Estimated	Actual	Excess
	Rs.	Rs.	Rs.
1. Cess Collections ...	180,600	246,051	65,451
2. Interest ...	3,000	7,349	4,349
3. Sale of Publications ...	800	1,766	966
4. Profit from Dartonfield Estate ...	21,805	26,556	4,751
5. Profit from Nivitigalakele Experiment Station ...	5,370	10,911	5,541
6. Sundry Receipts ...	1,400	1,821	421
7. Profit from sales of Vulcanised Products —		48	48
	212,975	294,502	81,527

4. The reasons for the variations between the estimate and the actual income are as follows :—

Excesses :

1. Increased export quota.

2. Larger investments in long term securities.

3. Under-estimate and proceeds from sale of Advisory Circulars.

4. Realisation of higher prices for rubber.

5. Realisation of higher prices for rubber and larger sales of planting material.

6. Under-estimate.

5. **Profit from Dartonfield Estate.**—The details of the expenditure incurred and the revenue earned from Dartonfield Estate are set forth in the Working Account of the estate. The profit earned for the year under review (Rs. 26,556) is less than that earned for 1939 (Rs. 27,527) by Rs. 981.

6. **Profit from Nivitigalakele Experiment Station.**—The working of the Experiment Station for the year showed a profit of Rs. 10,911 as compared with the profit of Rs. 11,900 earned during the previous year. The details of the income earned and the expenditure incurred are set forth in the Experiment Station Working Account.

7. **Sale of Vulcanised Rubber Products.**—A Sales Account showing the income derived from the sale of finished goods left over at the end of 1939 is attached to this report. The profit of Rs. 48-37 realised by the sale is credited to the income for the year under review.

II. EXPENDITURE

8. **Revenue Expenditure.**—The total expenditure on Revenue Account exclusive of the amounts allowed for depreciation of fixed assets, the Passage and Audit Fee Reserves and the Reserve for 1940 (January to March) Contribution to the Staff Provident Fund amounted to Rs. 179,368 as compared with Rs. 165,488 of the previous year. The details of this expenditure are fully set forth in the Income and Expenditure Account. The whole of this expenditure was checked with supporting vouchers and accounts.

9. **Capital Account.**—The expenditure incurred on fixed capital assets during the year amounted to Rs. 11,261 as compared with Rs. 21,115 in the previous year. The details of this expenditure are as follows :—

Land including Development :—			
Dartonfield	...	...	1,510 09
Nivitigalakele	...	...	4,822 55
Buildings and Lines :—			
Dartonfield—Estate	...	...	394 96
Furniture and Fixed Equipment :—			
Dartonfield	...	...	602 20
Nivitigalakele		...	425 00
Power and Water Supply :—			
Dartonfield	...	...	1,767 32
Laboratory Apparatus	...	...	1,738 73
			11,260 85

10. A comparison between the original estimate and the expenditure incurred in respect of the year under review is shown in Statement 'A' attached.

11. The reasons for the major variations between the estimate and the actual expenditure, as furnished by the Director, are as follows :—

Savings :

5C-D. Over-estimate of Smallholdings Propaganda Officer's travelling requirements and of other items and economy in expenditure.

7A. Under-estimate of income from Wagolla Estate.

8D. Economical use of stationery, etc.

9. The cost of the Director's visit to Malaya and North East Indies fell below the amount estimated.

10A. Work postponed.

11D. Economy.

12A. Difference in exchange.

12F. Over-estimate of requirements.

13. The transfer of an amount incorrectly charged to buildings in previous years to the appropriate head.

14A. Tank constructed of cement instead of steel,

Excesses:

2A-F. Payment of acting allowance to two officers.

4B. Higher cost of printing and increased size of publications. Printing of Advisory Circulars was not estimated for.

6A. Increased cost of materials.

7B. Cost of upkeep of machinery and quantity and cost of rubber for experments. under-estimated.

8E. Increased issue of publications and increased postage rates for overseas correspondence.

10B. Increased cost of materials.

10C. Unexpected repairs to the water pump and engine at Nivitigalakele.

11E. Increased cost of materials.

12B. Cost of a new bicycle and payment of expenses for an accident to an employee.

12D. Basis of contribution changed to higher rate.

14D. Increased labour charges.

14H-I. Expenditure not estimated.

12. The excesses under the different items of expenditure except the following have been sanctioned by the Board :—

		Rs. cts.
1.	Travelling Expenses of Members ...	75 75
2A-F.	Emoluments of Senior Scientific Staff ...	1,404 93
4B.	Publications ...	1,149 31
6A.	Laboratory Equipment and Working Expenses	135 78
7B.	Factory Experiments ...	761 94
8A-C.	Emoluments of Office Staff ...	46 26
8E.	Postages and Telegrams ...	666 71
8F.	Advertising ...	14 36
10B.	Bungalows ...	158 52
10C.	Water and Power Supply ...	674 77
11A.	Dartonfield General Charges ...	23 44
11C.	Upkeep of Roads and Grounds ...	48 85
11E.	Power Supply ...	495 33
12B.	General Charges ...	166 48
12D.	Staff Provident Fund ...	3,110 55

			Rs. cts
14B.	Upkeep of Dartonfield immature areas	...	85 09
14H.	Pinnagoda Budwood Nurseries	...	77 04
14D.	Planting 10 acres Kosgahahena	..	262 95
14I.	Dartonfield Supply Nursery, 1934	...	8 92

III. CAPITAL ACCOUNT

13. The cost of fixed assets at December 31, 1939, stood at Rs. 691,250 of which a sum of Rs. 13,346 being value of Nivitigalakele cart roads and bridges erroneously charged in 1936 to Nivitigalakele buildings and lines has now been transferred to the appropriate head. A further sum of Rs. 90 being value of an all-iron gate supplied to Nivitigalakele from Dartonfield has also been transferred to the appropriate account. The expenditure incurred during the year on capital account amounted to Rs. 11,261 and the value of fixed assets at December 31, 1940, was therefore Rs. 702,511. The details of this amount together with the transfers between accounts referred to are set forth in the Capital Account.

IV. BALANCE SHEET

(a) Liabilities.

14. **Creditors—Rs. 6,109.**—Of this amount a sum of Rs. 5,599 represents the total amount due to creditors for goods purchased or services rendered in respect of the year and Rs. 510 being subscriptions for 1941 publications received in advance.

15. **Passage Fund Reserve—Rs. 3,375.**—The balance on December 31, 1939, was Rs. 4,614 and a sum of Rs. 1,000 was transferred to this fund during the year. An expenditure of Rs. 2,239 being cost of passages provided during the year for certain members of the Senior Staff was met from this fund and the balance left over on December 31, 1940, was Rs. 3,375.

16. **Depreciation Reserve—Rs. 106,627.**—This sum represents the amount set apart for the depreciation of the fixed assets of the Scheme. During the year a sum of Rs. 4,447 was utilised from this fund for replating electric storage batteries but only Rs. 4,000 was sanctioned by the Board for this item of expenditure. This excess of Rs. 446·62 requires the covering sanction of the Board. The amount transferred from revenue to this account during the year was Rs. 16,877 made up as follows :—

		Rs. cts.
Buildings and Lines :—		
Dartonfield at 3½% on Rs. 191,033-17	...	6,686 16
Nivitigalakele at 3½% on Rs. 33,740-92	...	1,180 93
Furniture and Fixed Equipment :—		
Dartonfield at 7½% on Rs. 24,785-69	...	1,858 93
Nivitigalakele at 7½% on Rs. 2,870-83	...	215 31
Water and Power Supply :—		
Dartonfield at 7½% on Rs. 27,812-12	...	2,085 91
Nivitigalakele at 7½% on Rs. 4,844-79	...	363 36
Machinery and Tools :—		
Dartonfield at 7½% on Rs. 67,899-91	...	5,092 49
Nivitigalakele at 7½% on Rs. 83-50	...	6 26
Dartonfield Accumulators at 20% on Rs. 2,459-85	...	491 97
Laboratory Apparatus at 7½% on Rs. 11,293-33	...	847 00
		18 828 32
Less Depreciation written off from 1936 to 1939 on Cart Roads and Bridges, Nivitigalakele Rs. 13,346-48 which was originally included in error under Buildings now transferred to Land including Development, etc.	...	1,951 64
		16,876 68

17. **Provident Fund Reserve—Rs. 58,326.**—The particulars of the receipts and payments on this account are shown in the Provident Fund Account attached to this report. The balance standing to the credit of this Fund at the beginning of the year was Rs. 51,681. The contributions by the staff during the three months January to March, 1940 amounted to Rs. 1,467 and those made from the funds of the Scheme during the year were Rs. 7.813. Of the amount contributed by the Scheme, a sum of Rs. 5.545 represents the bonus equivalent to the sum contributed by the staff during 1939 and Rs. 2,189 the interest due on the fund for 1939. During the year a sum of Rs. 2,639 was refunded to retiring officers of the Scheme.

18. **Reserve for Bonus Contribution to the Provident Fund—Rs. 4,014.** —This sum represents the Provident Fund bonus contribution for January to March, 1940 and interest due for 1940 from the funds of the Scheme, which was transferred to a Reserve Account pending transfer to the Provident Fund Reserve Account.

19. **Audit Fee Reserve—Rs. 611.**—This amount represents the balance of Rs. 11 out of the reserves for previous years and Rs. 600 being the estimated cost of audit payable in respect of the year under review charged to the income of the year on the directions of the Board of Management.

20. **Surplus Account—Rs. 215,006.**—This sum represents the accumulated cash surplus of the Scheme at December 31, 1940. The cash surplus at the beginning of the year was Rs. 133,624. The excess of income over expenditure for the year was Rs. 92,643 The net capital expenditure incurred during the year was Rs. 11,261. There was, therefore, a cash surplus for the year amounting to Rs. 81,382 which increased the total cash surplus at the end of the year to Rs. 215,006.

(b) Assets.

21. **Debtors—Rs. 41,011.**—Of this amount, a sum of Rs. 25,740 represents the amount due from the Deputy Financial Secretary on account of Cess Collections made during December, 1940 and which was received from him in January, 1941. The balance Rs. 15,271 was due from various persons in respect of produce, etc., sold and labour lent.

22. **Advance Account—Rs. 2,258.**—The details of the items making up the balance on this account are given in the Balance Sheet. The advances to the Superintendent of Dartonfield, Nivitigalakele and Wagolla Estates and the Smallholdings Propaganda Officer were for sundry expenses and the amount shown against the Postmaster-General represents the amount deposited with him in respect of trunk call and other telephone fees.

23. **Accrued Interest on Investments—Rs. 1,656.**—This sum represents the amount of interest accrued for year on the investments of the cash balances but not received during the year.

24. **Payments in Advance—Rs. 654.**—This sum represents the money paid during 1940 for expenditure incurred on the Nivitigalakele New Clearing of 1941 and Dartonfield Replanting of 1941.

25. **Estate Stocks—Rs. 2,336.**—This amount is made up of Rs. 693 being the value of the balance rice in hand and Rs. 1,643 the value of other stores in hand on December 31, 1940.

26. **Loans to Officers—Rs. 1,620.**—This sum represents the balance outstanding out of the loans granted to two members of the staff for purchase of transport and to a member of the office staff for relief of financial distress as specially sanctioned by the Board of Management. The loans are being repaid in instalments with interest.

27. **Investments in Ceylon Government Loans - Rs. 130,000.**—The stock certificates relating to the Rs. 25,000 Ceylon Government 3½ per cent loan 1957-62 and the Rs. 105,000 Ceylon Government 3¼ per cent loan 1949-51 were inspected. These sums as appearing in the Balance Sheet represent the face value of the respective loans but the prices at which the 3½ per cent loan and 3¼ per cent loan were quoted in the market at December 31, 1940, were 101½ and 101¾ respectively at which rates the value of the investments would be Rs. 25,375 and Rs. 106,837-50 respectively.

28. **Cash Balances—Rs. 214,532.**—The receipts in support of the fixed deposits in banks amounting to Rs. 140,000 were inspected and the sum of Rs. 4,156 lying in deposit at the Ceylon Savings Bank was verified by reference to the connected pass book. The balances in current account with the National Bank of India, Limited, were verified by reference to the bank certificates. The balance of cash in hand at December 31, 1940, was not verified but a surprise verification of the cash in hand was made on March 20, 1941.

29. In accordance with the decision reached by the Board of Management on June 10, 1940, the administration of the Provident Fund under the Scheme as from April 1, 1940, was vested in a Board of Trustees consisting of persons nominated by the Board. The funds of the Provident Fund prior to April 1, 1940, are still under the control of the Board of Management and the transactions relating to them are described in paragraphs 17 and 18 of this report. The joint contributions from April to December, 1940, under the new provident fund scheme administered by the Board of Trustees amounted to Rs. 13,462 and a dividend at 1 per cent from the income earned from the investments was declared at the end of the year. The stock certificate relating to the Rs. 5,000 Ceylon Government 3¼ per cent loan 1949-51 purchased at 101½ was inspected and the sum of Rs. 2,000 deposited in the Ceylon Savings Bank was verified with the connected pass book. The balance cash in bank was verified with the bank certificate. The details of the assets and liabilities are reflected in a separate Balance Sheet attached to this report.

V. GENERAL

30. The accounts were received monthly and examined in this office. The office of the Scheme at Dartonfield Estate was visited once in respect of the accounts for the year under review and the books and accounts kept were checked and the cash in hand verified.

I am, Sir,

Your Obedient Servant,

(Sgd.) O. E. GOONETILLEKE,
Auditor-General

RUBBER RESEARCH SCHEME (CEYLON)

Dartonfield Estate

Working Account for the year ended 31st December, 1940

Dr. | Cr.

Nivitigalakele Experiment Station

Working Account for the year ended 31st December, 1940

Dr. | Cr.

	Rs. cts.	Rs. cts.		Rs. cts.
To Expenditure —			By Sale of Produce —	
General Charges	1,815 66		Rubber (28,849 lbs.) and Coupons	16,387 49
Upkeep, Cultivation, Manufacture, and Distribution	5,089 83	6,905 49	,, Planting Material	6,224 36
Upkeep of Nurseries		2,480 45	,, Cover Crop seed	152 10
Collection and Distribution of bud-wood and budded stumps		2,442 57	Food Crops	13 96
Planting, Upkeep and Harvesting of Food Crops		148 67		
Balance transferred to Revenue Account		10,940 74		
	Rs. 22,777 91			Rs. 22,777 91

Vulcanised Products

Sales Account for the year ended 31st December, 1940

Dr. | Cr.

	Rs. cts.		Rs. cts.
To Value of stock on hand on January 1, 1940	67 13	By Sales	115 50
Balance transferred to Revenue Account	48 37		
	Rs. 115 50		Rs. 115 50

PROVIDENT FUND

Working Account for the year ended 31st December, 1940

(1) Fund administered by the Board

Dr. | Cr.

	Rs. cts.			Rs. cts.
To Payments to two retiring Officers	2,639 15	By Balance brought forward from 1939		51,685 80
Balance carried forward ...	58,826 20	,, Board's Contribution for 1939 —		
		Bonus	Rs. cts. 5,544 82	
		Interest on officers' Contributions	1,160 68	
		Interest on Bonus	1,028 54	7,734 04
		Members' contributions January March, 1940		1,406 96
		Bonus and Interest for 1940 paid to two retiring Officers		78 47
	Rs. 60,985 17			Rs. 60,985 17

Audited and found correct

(Sgd.) O. L. GOONETILLEKE,

Auditor-General.

RUBBER RESEARCH SCHEME (CEYLON)

Revenue Account for the year ended 31st December, 1940

Dr. Cr.

	Rs. cts.	Rs. cts.		Rs. cts.
To Personal Emoluments:—			By Balances from Estate Working Accounts:—	
Senior Scientific Staff ...	73,929 93		Dartonfield	26,556 13
Junior Scientific Staff	6,098 40		Nivitigalakele	10,910 73
Office Staff ..	8,726 26	88,754 59	Cess Collections	246,050 79
,, Library & Publications:—			,, Interest	7,349 08
Library	876 08		,, Sale of Publications	1,765 71
Publications	2,599 31	3,475 39	,, Sundry Receipts	1,821 07
,, Smallholdings Work:—			,, Balance of Sale of Vulcanised Products Account	48 37
Salaries and Allowances	16,503 31			
Travelling and General Expenses	8,115 71	24,619 02		
,, Laboratory:—				
Equipment and Working Expenses	3,794 85			
Furniture Replacements	44 63	3,839 48		
,, Field and Factory Experiments:—				
Field Experiments	4,259 14			
Factory Experiments	2,532 94			
Budding Instruction	827 16	7,619 24		
,, Office:—				
Stationery and Office Equipment	2,158 02			
Postages and Telegrams	2,666 71			
Advertising	214 36			
Telephones	995 00			
Audit	600 00	6,634 09		
,, Travelling:—				
Expenses of Board Members	2,075 75			
Expenses of Staff	6,919 65	8,995 40		
,, Maintenance of Buildings, Water and Power Supply:—				
Laboratories and Offices	22 75			
Bungalows	1,158 52			
Water and Power Supply	1,074 77	2,256 04		
,, Miscellaneous Items shared with Estate:—				
Dartonfield General Charges	6,246 44			
Nivitigalakele .. Charges	1,815 66			
Upkeep of Roads and Grounds	565 85			
Factory Upkeep	716 30			
Power Supply	3,030 33	12,374 58		
,, Contingencies:—				
Contribution to London Advisory Committee	11,686 97			
General Charges	916 48			
Insurances	1,837 57			
Staff Prov. Fund:—				
Reserve for 1940 Contribution (January to March) Rs. 4,013 86				
Contribution April to December, 1940 Rs. 6,846 69	10,860 55			
Contribution to Passage Fund Reserve	1,000 00			
Entertainment Allowance	112 95	26,414 52		
Depreciation		16,876 68		
Balance, being excess of Income over Expenditure for the year, carried forward to Balance Sheet		92,642 85		
	Rs. 294,501 88			Rs. 294,501 88

RUBBER RESEARCH SCHEME (CEYLON)

Capital Account as at 31st December, 1940

EXPENDITURE	To December 31, 1939 Rs. cts.	Transfers between Accounts Rs. cts.	Additions in 1940 Rs. cts.	Total Rs. cts.
To Land including Development :—				
Dartonfield	109,562 53	90 00 cr.	1,510 09	110,982 62
Nivitigalakele	102,579 12	13,346 48 } 90 00 }	4,822 55	120,838 15
„ Buildings and Lines :—				
Dartonfield				
Estate	33,733 83	—	394 96	34,128 79
Headquarters ...	182,695 13	—		182,695 13
Nivitigalakele:—				
Estate	28,015 26	13,346 48 cr.	—	14,668 78
Headquarters ...	21,903 65	—	—	21,903 65
„ Furniture and Fixed Equipment :—				
Dartonfield	33,544 12	—	602 20	34,146 32
Nivitigalakele	4,235 85	—	425 00	4,660 85
„ Power and Water Supply :—				
Dartonfield	34,354 33	—	1,767 32	36,121 65
Nivitigalakele	5,287 58	—		5,287 58
„ Machinery and Tools :—				
Dartonfield	97,045 90	—	—	97,045 90
Nivitigalakele	105 50	—	—	105 50
„ Laboratory Apparatus ...	26,853 73		1,738 73	28,592 46
„ London Plant	11,333 34	—		11,333 34
	Rs. 691,249 87	—	11,260 85	702,510 72

RECEIPTS	Rs. cts.
By Revenue applied for Capital purposes at December 31, 1939	691,249 87
In 1940	11,260 85
	Rs. 702,510 72

GENERAL BALANCE SHEET AS AT 31st DECEMBER, 1940

LIABILITIES	Rs. cts.	Rs. cts.
Creditors :—		
Sundries	5,598 59	
Subscriptions for 1941 publications received in advance ...	510 00	6,108 59
Passage Fund Reserve :—		
At December 31, 1939	4,613 74	
Add Reserve for 1940	1,000 00	
	5,613 74	
Less Payments	2,238 62	3,375 12
Depreciation Reserve :—		
At December 31, 1939	94,196 70	
Add Reserve for 1940	16,876 68	
	111,073 38	
Less cost of replating batteries	4,446 62	106,626 76
Provident Fund Reserve :—		
At December 31, 1939	51,685 80	
Addition during 1940	6,640 22	58,326 02
Reserve for Bonus Contribution to the Provident Fund ...		4,049 86
Audit Fee Reserve :—		
At December 31, 1939	605 20	
Add Reserve for 1940	600 00	
	1,205 20	
Less Payments in 1940	594 39	610 81
Surplus Account :—		
At December 31, 1939	133,623 59	
Add Excess of Income over Expenditure in 1940 ...	92,642 85	
	226,266 44	
Less Contribution to Capital Outlay in 1940	11,260 85	215,005 59
		Rs. 394,066 75

ASSETS	Rs. cts.	Rs. cts.
Debtors :—		
Cess Collection for December, 1940	25,740 49	
Sundries	15,270 85	41,011 34
Advance Accounts :—		
London Advisoy Committee	1,576 60	
Estate Superintendent :—		
Dartonfield ... ... Rs. 230 66		
Nivitigalakele ... ... „ 248 56		
Wagolla ... ... „ 17 07 ...	496 29	
Smallholdings Propaganda Officer	75 02	
Postmaster-General	110 00	2,257 91
Accrued interest on investments		1,656 05
Payments in Advance		653 81
Estate Stocks		2,335 79
Loans to Officers		1,620 00
Investments :—		
In Ceylon Govt. 3½% Loan, 1957/62	25,000 00	
„ „ „ 3¼% „ 1949/51	105,000 00	130,000 00
Cash Balances :—		
At Ceylon Savings Bank	4,156 20	
On Fixed Deposit	140,000 00	
On Current Account No. 1	63,884 77	
On Current Account No. 2	6,240 02	
In hand	250 86	214,531 85
		Rs. 394,066 75

I certify that the above Balance Sheet presents a true and correct view of the financial affairs of the Rubber Research Scheme (Ceylon) as shown by the books on December, 31, 1940.

Audit Office,
Colombo, March 31, 1941.

(Sgd.) O. E. GOONETILLEKE,
Auditor-General.

PROVIDENT FUND

(2) Fund administered by Board of Trustees

Revenue Account for the period 1st April to 31st December, 1940

	Rs. cts.		Rs. cts.
To Sundry Charges :—		By Interest :—	
National Bank of India Ltd,, for one cheque book	2 83	Rubber Research Board at 3% on contributions April to August	37 32
„ Balance carrid over to Members' Dividend A/c.	171 36	Ceylon Government 3¼% Loan 1949/51 :—	
		Received ... ... Rs 81 25	
		Accrued due ... ... „ 40 62	121 87
		Ceylon Savings Bank	15 00
	Rs. 174 19		Rs. 174 19

MEMBERS' DIVIDEND ACCOUNT

	Rs. cts.		Rs. cts.
To Dividend Distribution to Members at 1% for 1940	133 86	By Amount transferred from Revenue Account	171 36
„ Balance carried over to Balance Sheet	37 50		
	Rs. 171 36		Rs. 171 36

BALANCE SHEET AS AT 31st DECEMBER, 1940

LIABILITIES	Rs. cts.	Rs. cts.
Members' Account :—		
Joint Contributions April to December, 1940 ...	13,461 80	
Dividend distributed at 1%	133 86	13,595 66
Members' Dividend Account :		37 50
		Rs. 13,633 16

ASSETS	Rs, cts,	Rs, cts.
Investments :—		
Ceylon Government 3¼% Loan 1949/51 ...	5,075 00	
Ceylon Savings Bank	2,000 00	7,075 00
Accrued Interest		55 62
Cash :—		
On Current Account		6,502 54
		Rs. 13,633 16

I certify that the above Balance Sheet presents a true and correct view of the financial affairs of the Provident Fund administered by the Board of Trustees, as shown by the books on December 31, 1940.

Audit Office,
Colombo, March, 31, 1941

(Sgd) O. E. GOONETILLEKE,
Auditor-General.

STATEMENT 'A'

Account	Estimate	Actual	Excess	Supplementary Provision & Revotes.	Saving
	Rs.	Rs.	Rs.	Rs.	Rs.
1. Administration of the Board:					
Travelling Expenses of Members ...	2,000	2,076	76	—	—
2 A-F. Personal Emoluments of Senior Scientific Staff ...	72,525	73,930	1,405	—	—
3 A-F. Personal Emoluments of Junior Scientific Staff ...	6,195	6,098	—	—	97
4. Library and Publications:					
A. Library ...	1,500	876	—	—	624
B. Publications ...	1,450	2,599	1,149	—	
5. Smallholdings Work:					
A.B. Salaries and Rent Allowances of Staff ...	16,515	16,503	—	—	12
C.-D. Travelling and General Expenses ...	11,019	8,116	—	—	2,903
6. Laboratory:					
A. Equipment and Working Expenses ...	6,000	6,136	136	—	
B. Furniture Replacements	50	45	—	—	5
7. Field and Factory Experiments:					
A. Field Experiments ...	4,468	4,259	—	—	209
B. Factory Experiments ...	1,771	2,533	762	—	—
C. Budding Instruction ...	853	827	—	—	26

STATEMENT 'A' (*contd.*)

Account	Estimate	Actual	Excess	Supplementary Provision & Re-votes.	Saving
	Rs.	Rs.	Rs.	Rs.	Rs.
8. Office:					
A-C. Emoluments of Office Staff ...	8,680	8,726	46	—	—
D. Stationery & Office Equipment ...	2,500	2,583	83	425	342
E. Postages & Telegrams ...	2,000	2,667	667	—	—
F. Advertising ...	200	214	14	—	—
G. Telephone ...	1,000	995	—	—	5
H. Audit ...	600	600	—	—	—
9. Travelling Expenses of Staff	5,000	6,920	1,920	2,500	580
10. Maintenance of Buildings, Water and Power Supply:					
A. Laboratories & Offices	250	23	—	—	227
B. Bungalows ...	1,000	1,159	159	—	—
C. Water & Power Supply	400	1,075	675	—	—
11. Miscellaneous Items Shared with Estate:					
A. Dartonfield General Charges ...	5,610	6,246	636	613	—
B. Nivitigalakele General Charges ...	1,844	1,816	—	30	58
C. Upkeep of Roads and Grounds ...	517	566	49	—	—
D. Factory Upkeep ...	525	716	191	275	84
E. Power Supply ...	2,535	3,030	495	—	—

STATEMENT 'A' (*contd.*)

Account	Estimate	Actual	Excess	Supplementary Provision & Re-votes.	Saving
	Rs.	Rs.	Rs.	Rs.	Rs.
12. Contingencies:					
A. Contribution to London Advisory Committee	12,000	11,687	—	—	313
B. General Charges	750	916	166	—	—
C. Insurance Charges ...	1,100	1,838	738	750	12
D. Staff Provident Fund ...	7,750	10,861	3,111	—	—
E. Passages ...	1,000	1,000	—	—	—
F. Entertainment Allowance ...	300	113	—	—	187
13. Depreciation	19,250	16,877	—	—	2,373
14. Capital Account:					
A. Storage Tank for Latex ...	700	395	—	—	305
B. Upkeep of Dartonfield Immature Areas ...	1,425	1,510	85	—	—
C. Upkeep of Nivitigalakele Immature Areas ...	1,418	1,354	—	—	64
D. Planting 10 acres Kosgahahena, Nivitigalakele	2,087	2,350	263	—	—
E. Opening 3 acres Nursery Nivitigalakele ...	654	652	—	—	2
F. Replanting 3 acres Nivitigalakele ...	438	390	—	—	48
G. Water and Power Scheme	—	1,767	1,767	1,767	—
H. Pinnagoda Budwood Nurseries ...	—	77	77	—	—
I. Dartonfield Supply Nursery 1934 ...	—	9	9	—	—

ESTIMATES FOR 1941

(Adopted by the Board, October 28, 1940)

INCOME

		Rs.
1.	Cess Collections	213,640
2.	Interest	6,500
3.	Sale of Publications	800
4.	Profit from Dartonfield	15,530
5.	Profit from Nivitigalakele	7,124
6.	Sundry Receipts	1,400
		Rs. 244,994

REVENUE EXPENDITURE

			Rs.	Rs.
1	**Administration of the Board:**			
	Travelling Expenses of Members ...	...		2,000
2.	**Personal Emoluments:**			
	Senior Scientific Staff ...	...	76,575	
	Junior Scientific Staff ...	...	6,790	83,365
3.	**Library and Publications:**			
	Library ...	...	1,500	
	Publications ...	...	2,000	3,500
4.	**Smallholdings Work:**			
	Salaries and Allowances ...	...	18,187	
	Travelling and General Expenditure	...	11,933	30,120
5.	**Laboratory:**			
	Equipment and Working Expenses	...	5,000	
	Furniture Replacements ...	...	50	5,050
6.	**Field and Factory Experiments:**			
	Field Experiments ...	...	5,684	
	Factory Experiments ...	...	2,811	
	Budding Instruction ...	...	913	9,408
7.	**Office:**			
	Salaries of Office Staff ...	...	8,956	
	Stationery and Office Equipment ...	...	2,750	
	Postages and Telegrams ...	...	2,000	
	Advertising ...	...	200	
	Telephone ...	...	1,000	
	Audit ...	...	600	15,506
8.	**Travelling of Staff** ...	...		5,000
9.	**Maintenance of Buildings:**			
	Laboratories and Offices ..	...	250	
	Bungalows ...	...	1,000	
	Water and Power Supply ...	...	500	1,750
		Carried over		155,699

		Rs.	Rs.
	Brought forward		155,699
10.	**Miscellaneous Items Shared with Estate:**		
	Dartonfield General Charges	5,199	
	Nivitigalakele General Charges	2,027	
	Upkeep of Roads and Grounds	574	
	Factory Upkeep	487	
	Power Supply	3,169	11,456
11.	**Contingencies:**		
	Contribution to London Advisory Committee	12,000	
	General Charges	750	
	Insurance Charges	1,750	
	Staff Provident Fund	13,055	
	Passages	5,000	
	Entertainment Allowance	300	32,855
12.	**Depreciation**		19,300
			Rs. 219,310

CAPITAL EXPENDITURE

	Rs.	Rs.
Buildings:		
Manure Shed at Pinnagoda		516
Equipment:		
Furniture for Soils Laboratory	111	
Almirah for Estate Office	80	
Latrine seats for infants at lines	80	271
Water Supply to Lines		219
Immature Areas:		
Dartonfield	2,368	
Nivitigalakele	6,014	8,382
		Rs. 9,388

SUMMARY

	Rs.	Rs.
Income		244,994
Expenditure:		
Revenue	219,310	
Capital	9,388	228,698
Excess of Income over Expenditure		16,296

PRINTERS:
H. W. CAVE & Co.
COLOMBO.